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ABSTRACT

These materials for a six-unit course were developed to help teachers help students develop technological literacy, career exploration, and problem-solving skills relative to the construction industry. The six units include an overview of construction, construction safety, design and planning, construction preparation, construction processes, and project completion. The first section is designed to teach teachers how to use the materials and includes an explanation of instructional elements, an instructional-task analysis for each unit, and a list of 15 references. The instructional elements for the units include objectives, suggested activities, a list of supplemental resources, information sheets, transparency masters, assignment sheets, job sheets, tests, and test answers. Some elements, such as the information sheets, include photographs, diagrams, and line drawings. (CML)

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EXPLORING CONSTRUCTION TECHNOLOGY

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Mary Kellum

Developed by

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EXPLORING CONSTRUCTION TECHNOLOGY

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FOREWORD

Technology education/industrial arts instructors are being asked to make radical changes in their programs to reflect the radical changes in our technological society. Rapid change and the current clamor for educational reform have made it evident that improvements must be made to meet the needs of students who will compete in a world quite different from the one they are experiencing in the classrooms and laboratories.

We are at the point where we need to overhaul traditional industrial arts programs and bring new and emerging technologies into the curriculum. However, the lack of instructional materials to support this new curriculum effort has made it extremely difficult. Hopefully, the new **MAVCC Technology Education Series** will aid teachers in updating and revitalizing their programs.

The series begins with *Exploring Technology Education*, Level I, which is followed by four Level II books which individually explore the technology systems of communication, construction, manufacturing, and energy, power, and transportation.

The book you are holding, *Exploring Construction Technology*, is one of the Level II publications in this series. It has been developed to give students technological literacy, career exploration, and problem-solving skills dealing with the construction industry.

Every effort has been made to make this publication basic, readable, and by all means, usable. Three vital parts of instruction have been intentionally omitted from the publication: motivation, personalization, and localization. These areas are left to the individual instructors who should capitalize on them. Only then will these publications become a vital part of the teaching-learning process.

Bob Patton, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

Greg Pierce
Executive Director
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Appreciation is extended to those individuals who contributed their time and talents in the development of *Exploring Construction Technology.*

The contents of this publication were planned and reviewed by the following members of the Mid-America Vocational Curriculum Consortium technology education committee:

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Special appreciation is extended to **Dr. Kendall Starkweather** of Reston, Virginia for representing the International Technology Education Association (ITEA) on this committee.

Gratitude is expressed to the employees of the Graphics Division of the Oklahoma State Department of Vocational-Technical Education for their assistance with the phototypesetting, artwork, pasteup, and printing of this text.

Thanks are also extended to **Mary Kellum,** MAVCC Publication Specialist, for her assistance with the editing of this book, as well as the coordination of the entire project.

USE OF THIS PUBLICATION

Instructional Units

Exploring Construction Technology contains six units of instruction. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated

    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

EXPLORING CONSTRUCTION TECHNOLOGY

INSTRUCTIONAL TASK ANALYSIS

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What the Student Should Know (Cognitive)

UNIT I: OVERVIEW OF CONSTRUCTION

1. Terms and definitions
2. Major types of construction
3. Resources used in construction
4. Steps in producing constructed works
5. Major groups of construction workers
6. Education and training required for the groups of construction workers
7. Construction job titles and descriptions
8. Personnel practices in construction
9. Labor/management practices
10. Construction and the future
11. Evaluate your home
12. Construct a site box

UNIT II: CONSTRUCTION SAFETY

1. Laboratory and site safety
2. Personal safety practices
3. Housekeeping practices
4. Basic types of ladders
5. Correct ladder use
6. Rules for using common portable power tools

PRACTICAL APPLICATION: What The Student Should Be Able To Do (Psychomotor)	RELATED INFORMATION: What the Student Should Know (Cognitive)
	7. General safety for portable power tools
8. Complete a safety pledge	
9. Survey laboratory facilities	
10. Identify unsafe construction practices	
11. Complete a word search of safety terms	
UNIT III: DESIGN AND PLANNING	
	1. Terms and definitions
	2. Steps in the design and engineering process
	3. Types of public construction projects
	4. Building codes
	5. Building standards and material specifications
	6. Types of soil tests
	7. Types of legal land descriptions
	8. Working drawings
	9. Factors involved in cost estimating
	10. Steps in securing a building permit
	11. Types of bridges
12. Select and purchase a construction site	
13. Research a legal land description	
14. Design and build a truss bridge	
15. Stress test a truss bridge	

PRACTICAL APPLICATION: What The Student Should Be Able To Do (Psychomotor)	RELATED INFORMATION: What the Student Should Know (Cognitive)
UNIT IV: CONSTRUCTION PREPARATION	
	1. Terms and definitions
	2. Types of surveying for construction projects
	3. Basic surveying equipment
	4. Major parts of a level
	5. Types of contractors
	6. General types of contracts
	7. Steps in securing a contract
	8. Steps in scheduling construction
	9. Procedures required when preparing to build
	10. Site clearing methods
	11. Earthmoving equipment
	12. Types of excavating
13. Plan to clear a site	
14. Estimate a site clearing project	
15. Set up and adjust a level	
16. Locate a structure	
UNIT V: CONSTRUCTION PROCESSES	
	1. Terms and definitions
	2. Major parts of a foundation
	3. Types of foundations
	4. Materials used for foundations
	5. Steps in setting foundations

PRACTICAL APPLICATION: What The Student Should Be Able To Do (Psychomotor)	RELATED INFORMATION: What the Student Should Know (Cognitive)
	6. Types of frames for superstructures
	7. Structural steel shapes used for frame construction
	8. Steps in constructing steel frames
	9. Steps in constructing concrete frames
	10. Steps in constructing wood frames
	11. Steps used in erecting a structure
	12. Outside utility systems
	13. Inside utility systems
	14. Sequence for roughing in the inside utility systems
	15. Reasons for insulating structures
	16. Types of insulation and methods for adding them
	17. Common areas to insulate
	18. Enclosing the exterior
	19. Enclosing the interior
	20. Finishing the project
21. Pour a concrete foundation	
22. Build a wood frame structure	
23. Rough in copper water lines	
24. Rough in plastic water lines	
25. Rough in electrical power systems	
26. Layout and construct a roof truss	
27. Frame a roof	
28. Install siding	

PRACTICAL APPLICATION: What The Student Should Be Able To Do (Psychomotor)	RELATED INFORMATION: What the Student Should Know (Cognitive)
29. Enclose a roof	
30. Trim the outside of a structure	

UNIT VI: PROJECT COMPLETION

	1. Definition of landscaping
	2. Purposes of landscaping
	3. Steps in the landscaping process
	4. Landscaping procedures
	5. Transferring the project
	6. Final inspection
	7. Steps in closing a contract
	8. Procedures for servicing the project
9. Make a landscape plan	
10. Make final inspections	
11. Close the contract	
12. Plant a site	

REFERENCES

A. *Accident Prevention for Industrial Arts Vocational and Technical Education Programs.* Stillwater, OK: Oklahoma State Department of Vocational and Technical Education.

B. *Competitive Events Guidelines,* revised edition. Reston, VA. National AIASA, 1985.

C. Davis, Ronald and Bruce Yancey: *Architectural Drafting.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1982.

D. Feirer, John L. and Gilbert R. Hutchings. *Guide to Residential Carpentry.* Peoria, IL: Bennett Publishing Company, 1983.

E. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

F. Hendrix Laborn J. *Fundamentals of Carpentry.* Stillwater, OK: AGC and Oklahoma State Department of Vo-Tech Education, 1985.

G. Hendrix, Laborn J. *Residential Carpentry.* Stillwater, OK: AGC and Oklahoma State Department of Vo-Tech Education, 1985.

H. Hoag, John S. *Fundamentals of Land Measurement.* Chicago, IL: Chicago Title Insurance Co., 1971.

I. Lux, Donald G., et. al. *World of Construction.* Bloomington, IL: McKnight Publishing Co., 1982.

J. Olson, David A. *Basic Surveying Technology.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1987.

K. Reader's Digest. *Complete Do-It-Yourself Manual.* Pleasantville, NY: Reader's Digest Assoc., Inc., 1973.

L. Smith, Eddie. *Agricultural Mechanics.* Stillwater, OK: CIMC/Oklahoma State Department of Vo-Tech Education, 1977.

M. Spence, William P. *Architecture.* Peoria, IL: Bennett and McKnight Publishing Co., 1985.

N. Todd, R., D. McCrory, K. Todd. *Understanding and Using Technology,* Worcester, MA: Davis Publications, Inc., 1985.

O. Wright, R. Thomas, and Richard M. Henak. *Exploring Production.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

OVERVIEW OF CONSTRUCTION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to describe the major components of a typical construction system and participate as a member of a construction group. Competencies will be demonstrated by completing the assignment sheet, job sheet, and the unit tests with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to construction with the correct definitions.
2. Distinguish between the major types of construction.
3. Match resources used in construction with the correct descriptions.
4. Distinguish between the steps in producing constructed works.
5. Match major groups of construction workers with the correct descriptions.
6. Match the education and training required with the correct groups of construction workers.
7. Match construction job titles with the correct descriptions.
8. Match personnel practices in construction with their correct descriptions.
9. Select true statements concerning labor/management practices.
10. Complete statements concerning construction and the future.
11. Evaluate your home. (Assignment Sheet #1)
12. Demonstrate the ability to construct a site box. (Job Sheet #1)

OVERVIEW OF CONSTRUCTION
UNIT I

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheet.

H. Discuss and demonstrate the procedure outlined in the job sheet.

I. Integrate the following activities throughout the teaching of this unit:

1. Plan a class trip to visit as many types of construction as possible.

2. Plan to have the students survey a traffic area and discuss what changes will need to be made to meet future needs.

3. Have the students research to identify flood plains in your area. Discuss why there are building regulations to prevent building in an area that will flood.

4. Make a display board with advertisements for different construction jobs.

5. Contact a local union and request several copies of the working agreement regulations between the union and the contractor's association.

6. Discuss labor and management problems.

7. Role play the problem of better working hours between management and construction workers.

8. Present a scenario of life in the future that presents problems that could be solved by the construction industry. Have the students discuss or research how to solve those problems.

9. Discuss Handout #1 — Executive Preview of America's Infrastructure. Plan to show the tapes listed in the resource section.

(NOTE: The Associated General Constructors of America (AGC) is a national trade association representing all facets of the construction industry.)

SUGGESTED ACTIVITIES

10. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Lux, Donald G., et. al. *World of Construction.* Bloomington, IL: McKnight Publications, 1982.

B. Spence, William P. *Architecture.* Peoria, IL: Bennett and McKnight Publishing Company, 1979.

C. Wright, R. Thomas, and Richard M. Henak. *Exploring Production.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

D. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Videos

1. *Infrastructure,* VT09, 13 minutes
   Views different newsreels on the importance of repair throughout the nation on infrastructures. Also discusses cost.

2. *Infrastructure Newsreel,* VT10, 15 minutes
   National and local television newsreels explain the problems we have had dealing with old infrastructures in our nation.

3. *Water: America's Most Vital Resource,* VT11, 15 minutes
   With national newsreels this video explains the water leaks in the infrastructure reported in some cities that are causing extreme danger, and the expensive cost of repair.

4. *Buildings: Our Vertical Infrastructure,* VT12, 15 minutes
   National and local television reports document the decay of America's public buildings.

   (NOTE: Videos 1-4 are available from:

   Oklahoma State Department of Vocational and Technical Education
   1500 West Seventh Avenue
   Stillwater, OK 74074
   Attn: Film Library)

SUGGESTED SUPPLEMENTAL RESOURCES

5. *Brick and Stone Masonry*, CS-120
   Brick layers, tile setters, concrete block workers, supervisors and contractors are presented on location as they discuss their trade and its amenities. Apprenticeship programs, on-the-job training, and union affiliation are also discussed.

6. *Carpentry*, CS-121
   This program includes occupations concerned with constructing, renovating, and maintaining wooden structures using power saws, planes, hammers, and other carpentry tools. Levels of advancement are noted from apprenticeship to journeyman, foreman, and contractor. The role of the union in hiring practices is also explained.

7. *Concrete Finishing*, CS-122
   A group of occupations concerned with pouring and casting concrete at construction sites, leveling and smooth concrete, and erecting forms. Working conditions and training programs are noted. Management and the union are briefly discussed.

8. *Plastering, Painting, and Paperhanging*, CS-127
   Trades examined in this program are involved with applying a finishing material to a structural surface. House painters, drywallers, and ornamental plasterers are typical of these occupations. The advantages of each trade is presented and an outline of training requirements is discussed by foremen and site superintendents.

9. *Structural Metal Erectors*, CS-128
   This program presents a group of occupations concerned with raising, positioning, and joining prefabricated structural metal parts and subassemblies for buildings, bridges, tanks, and similar works. Instructors give an educational overview of the trade from apprentice to journeyman and foreman. A rep from the Iron Workers Union details the Union's role.

   (NOTE: Videos 5-9 are available in VHS and Beta from:

   Morris Video
   413 Avenue G #1
   P.O. Box 443
   Redondo Beach, CA 90277
   1-800-843-3606

B. Construction software (Apple, IBM, TRS-80, others)

1. *Tools*

2. *Framing Processes*

3. *Blueprint Reading*

4. *Estimating*

SUGGESTED ACTIVITIES

5. *Introduction to Solar Energy*

   Available from: National Innovative Media Co.
   Route #2, Box 301B
   Calhoun, KY 42327
   1-800-962-6662

C. *Construction: Basic Principles*
RMI Media Productions, Inc.
120 West 72nd Street
Kansas City, MO 64114

OVERVIEW OF CONSTRUCTION
UNIT I

INFORMATION SHEET

I. **Terms and definitions**

A. AFL-CIO (American Federation of Labor and Congress of Industrial Organizations) — A national labor group representing different kinds of workers

(NOTE: Construction workers are a part of the Building and Construction Trades Department. This department has ten member unions to cover the construction fields.)

B. Arbitration — The hearing and deciding of an issue in controversy by a person chosen by both sides

C. Construction industry — A managed production system that exists to build and service infrastructures that meet the needs of society

D. Grievance — A complaint made by laborers when they feel the management has acted unfairly

E. Infrastructure — System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living

Examples:

1. Building infrastructures — Houses, hospitals, schools, prisons, police and fire stations, libraries, museums, courthouses

2. Municipal utilities infrastructures — Potable water systems, wastewater treatment plants, drainage systems, flood control systems, curbs, gutters, sidewalks

3. Heavy industrial infrastructures — Locks, ports, waterways, dams, reservoirs, railroads, mass transit systems

4. Highway infrastructures — Highways, bridges, airports

F. Modules — Units constructed with standardized dimensions for flexibility and variety in use

G. Negotiation — Discussion between labor and management to settle differences

H. Prefabricated units — Parts manufactured in a factory and shipped to the building site so that parts only need to be assembled or united at the site

I. Strike — A last resort effort used by the union to force management to bargain

INFORMATION SHEET

II. Major types of construction

A. Residential or light construction — Concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings

(NOTE: These are primarily of wood frame construction.)

B. Commercial construction — Primarily involved with the erection of commercial, industrial, educational, and institutional buildings

(NOTE: The materials used include steel, concrete, brick, glass, plastics, and ceramics.)

INFORMATION SHEET

C. Civil and/or heavy construction — Includes railroads, earth-moving projects, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities

(NOTE: Many different materials are used such as gravel, earth, sand, steel, oil, wood, cement, glass, and plastic.)

III. **Resources used in construction** (Transparencies 1 and 2)

A. Materials — Natural resources and manufactured products

Examples: Electricity, water, lumber, glass, etc.

B. Equipment — Implements and tools

Examples: Hand tools, power tools, vehicles, cranes, etc.

C. Workers — People who operate the equipment and use the materials

Examples: Plumbers, carpenters, electricians, heavy equipment operators, etc.

D. Methods — Systematic procedures and techniques used in building

E. Management — People who plan, organize, direct, and control the work

INFORMATION SHEET

IV. Steps in producing constructed works (Transparency 3)

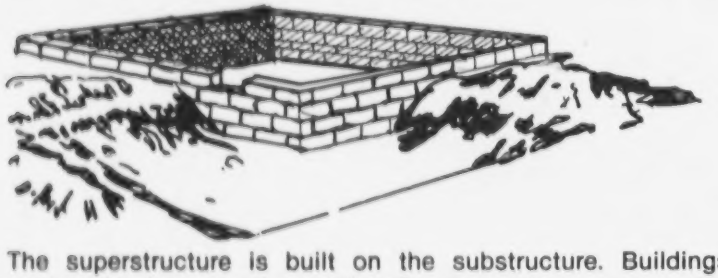
(NOTE: Many types of projects are built in the construction industry, such as dams, factories, highways, houses, and shops. They are all built using the same general procedures.)

A. Preprocessing — Includes receiving, handling, storing, and protecting materials and the site prior to construction.

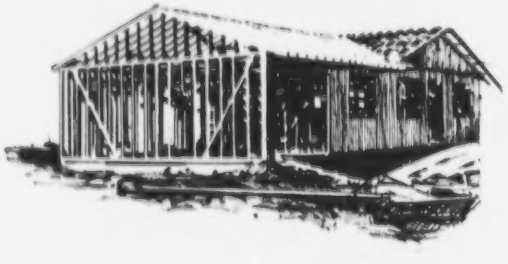
B. Processing — Includes separating, combining, and forming of material to produce a structure. The following steps are used.

1. The site is prepared by clearing away all unwanted objects. The site is surveyed to locate the exact place for the structure. Then earthmoving is done to reach the surface on which the structure will rest.

2. The foundation is set below ground level. It is called the substructure. The substructure will bear the weight of the whole structure.

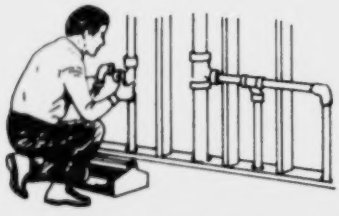


3. The superstructure is built on the substructure. Buildings are enclosed to keep out the weather. Some structures, such as bridges and roads, are not enclosed.

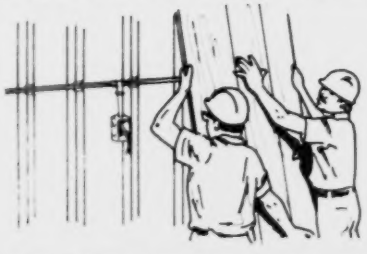


INFORMATION SHEET

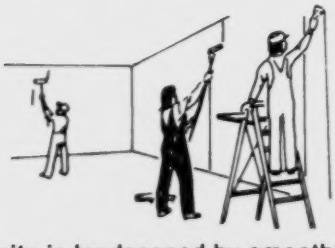
4. Utilities are installed to provide electricity, water, heat, cooling, and ventilated air. This requires wiring, plumbing, and ductwork.



5. The interior of the structure is enclosed (in a building). Inside surfaces are covered to hide utilities and improve appearance.



6. Surfaces are finished to protect the materials and improve their appearance. This mainly involves painting and decorating.



7. The site is landscaped by smoothing and shaping the land surface. Lawn, trees, and shrubs may be added.

C. Postprocessing (servicing) — Includes installing, maintaining, repairing, or altering the equipment or structure.

INFORMATION SHEET

V. Major groups of construction workers (Transparency 4)

A. Management workers — Plan, organize, and control production systems. There are many kinds and levels. They include community planners, estimators, contractors, supervisors, architects, and engineers.

B. Production workers — Carry out the plans of management. They do the on-site work. They have many different specialties including bricklayers, electricians, plumbers, and carpenters.

C. Office workers — Perform office tasks much like that done in any office. They include receptionists, secretaries, clerks, and accountants.

VI. Education and training required for construction workers

A. Management workers — Usually have 4-5 years of college education in engineering, architecture, or construction management; some management workers do not have a college education but instead have many years of experience in construction with perhaps some advanced classroom training in management or business.

B. Production workers — Usually are trained in a classroom and on the job through apprenticeship programs by working with skilled workers.

(NOTE: Apprentices normally receive 6,000 to 10,000 hours of on-the-job training and 144 hours or more of classroom instruction per year. Apprentices become skilled workers in about 4 years. Apprenticeships may be shortened if previous vocational or trade school training is completed and accepted.)

C. Office workers — Usually complete high school, vocational school, or college business and office training programs.

VII. Construction job titles and descriptions

A. Architect, designer, engineer

1. Provide professional services in research, development, design, construction, alteration, or repair of real property, such as private residences, office buildings, theaters, public buildings, or factories.

2. Consult with clients to determine size and space requirements and provide information regarding cost, design, materials, equipment, and estimated building time.

3. Plan layout of project and integrate engineering elements into unified design.

4. Prepare scaled, full-size drawings and contract documents for building contractors and production workers.

5. Furnish clients with sample recommendations and shop drawing reviews.

INFORMATION SHEET

B. Contractor, subcontractor

1. Contract to perform specified construction work in accordance with architect's plans, blueprints, codes, and other specifications.

2. Estimate costs of materials, labor, and use of equipment required to fulfill provisions of contract; prepare bids.

3. Confer with clients to negotiate terms of contract.

C. Construction superintendent

1. Manages projects that range in cost from a few thousand dollars to several million.

2. Directs the workers, and keeps track of schedules, budgets, methods, and procedures.

3. Oversees subcontractors and workers who have other special assignments.

D. Construction inspector

1. Inspects and oversees construction to assure quality.

   (NOTE: These inspections protect the consumer from faulty materials and workmanship.)

2. Measures distances to verify accuracy of dimensions of structural installations and layouts.

3. Verifies levels, alignment, and elevation of installations using surveyor's level and transit.

   (NOTE: Inspection is a necessary part of construction. It is an ongoing process. It starts at the beginning of the design process and continues until the contractor completes work. Many kinds of inspectors may become involved in a construction project.)

E. Construction worker

1. Performs any combination of duties on construction projects, usually working in utility capacity, by transferring from one task to another task where demands require workers with varied experience.

2. Measures distances from grade stakes.

3. Removes and cleans forms.

4. Sorts and stacks lumber.

5. Levels earth to the final grade specifications.

INFORMATION SHEET

VIII. Personnel practices in construction (Transparency 5)

A. Hiring includes:

1. Recruiting — Finding and attracting needed employees
2. Selecting — A screening process for choosing the best qualified person from among those who applied for the job
3. Inducting — Programs designed to make a new employee feel that they belong and to help them learn how to do their job as a team member

B. Career movement in an organization includes:

1. Promoting — Moving to a higher level job
2. Demoting — Moving to a lower level job
3. Transferring — Moving to a different job; usually at the same level and pay

C. Separating and retiring includes:

1. Separating — Firing, relocating, and laying off workers
2. Retiring — Withdrawing from an occupation at the end of a career

(NOTE: Retirement benefits are offered by many companies for employees who have worked for a certain length of time. Many construction workers belong to unions which have pension plans for retirees.)

IX. Labor/management practices

(NOTE: There are rules for work just as there are rules for games or sports. The rules for work are set by an agreement between the employer and the employees. This is done on an individual or group basis. It may be done by union or nonunion agreements.)

A. Unions are the way workers express their views as a group. They are organized by a legal procedure similar to the following:

1. Committees are formed to promote the union.
2. Authorization cards are signed.
3. The union is given the right to represent the workers.

INFORMATION SHEET

4. The National Labor Relations Board (NLRB) petitions for an election.

5. The workers vote for or against the union. If successful, the union is certified and becomes a bargaining agent for the workers.

6. A local chapter of the union is organized.

(NOTE: Union officers are elected to negotiate fair labor contracts with labor union officials.)

B. Labor contracts set down conditions under which the workers will work. They set:

1. Pay rates

2. Working hours

3. Working conditions

4. Procedures for settling disputes (grievances)

C. Collective bargaining is the process of union leaders working with company management leaders to discuss and decide issues.

Examples: Higher wages, better working conditions, other benefits

X. Construction and the future

A. Construction challenges for the future

(NOTE: Construction must provide for the needs of an ever-growing population. It must prepare for the future. It should make changes that will improve the lives of people in years to come.)

1. Housing must be built to meet the needs of the growing population.

2. Low income housing in large cities must be improved.

3. Building must make the best use of our resources.

4. Transportation facilities must be made more effective.

5. Manufacturing plants must be enlarged.

6. More efficient facilities are needed for education.

7. Facilities for reducing air and water pollution are needed.

8. Fuel must be conserved.

INFORMATION SHEET

B. Construction problems

1. The development of construction technology has been slow.
2. Society is resistant to change.
3. Labor practices and testing laboratory requirements are slow to change.
4. Hidden costs of building are very high.

   Examples: Legal, financial, and administrative charges, insurance

C. Construction changes to meet the challenge

1. New and improved designs

   Examples: Modular systems, prefabricated units

2. New and improved methods

   Examples: Improved management techniques, using computers for data processing and systems analysis

3. New and better materials

   Examples: Greater use of laminates, more use of plastics, improved metals, plasterboard, and clay products, increased use of prestressed and precast concrete

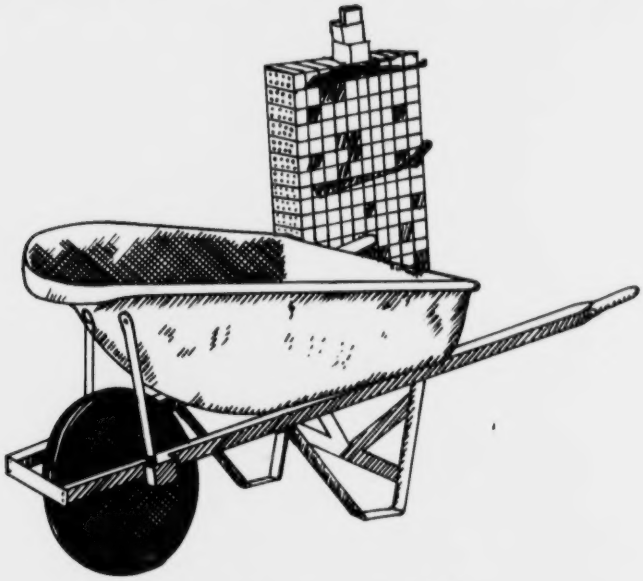
4. Labor

   Examples: More skilled labor will emerge. New skills will need to be learned. Retaining workers will become more and more important.

D. Future trends of construction

1. Cities of the future may be completely enclosed units.
2. Cities of the future will have less pollution. All wastes will be recycled.
3. Future transportation systems could be powered by propulsion units that do not pollute.

Resources Used in Construction



Materials

Equipment

Resources Used in Construction

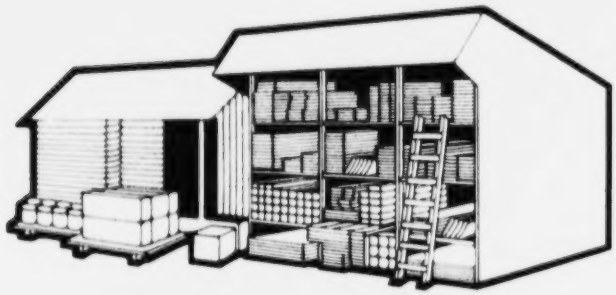
(Continued)

Workers

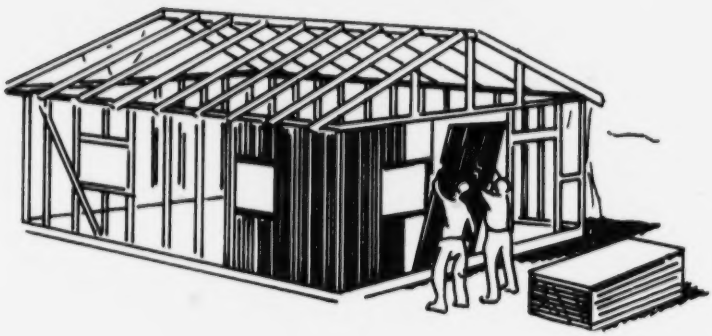
Methods

Management

Steps in Construction



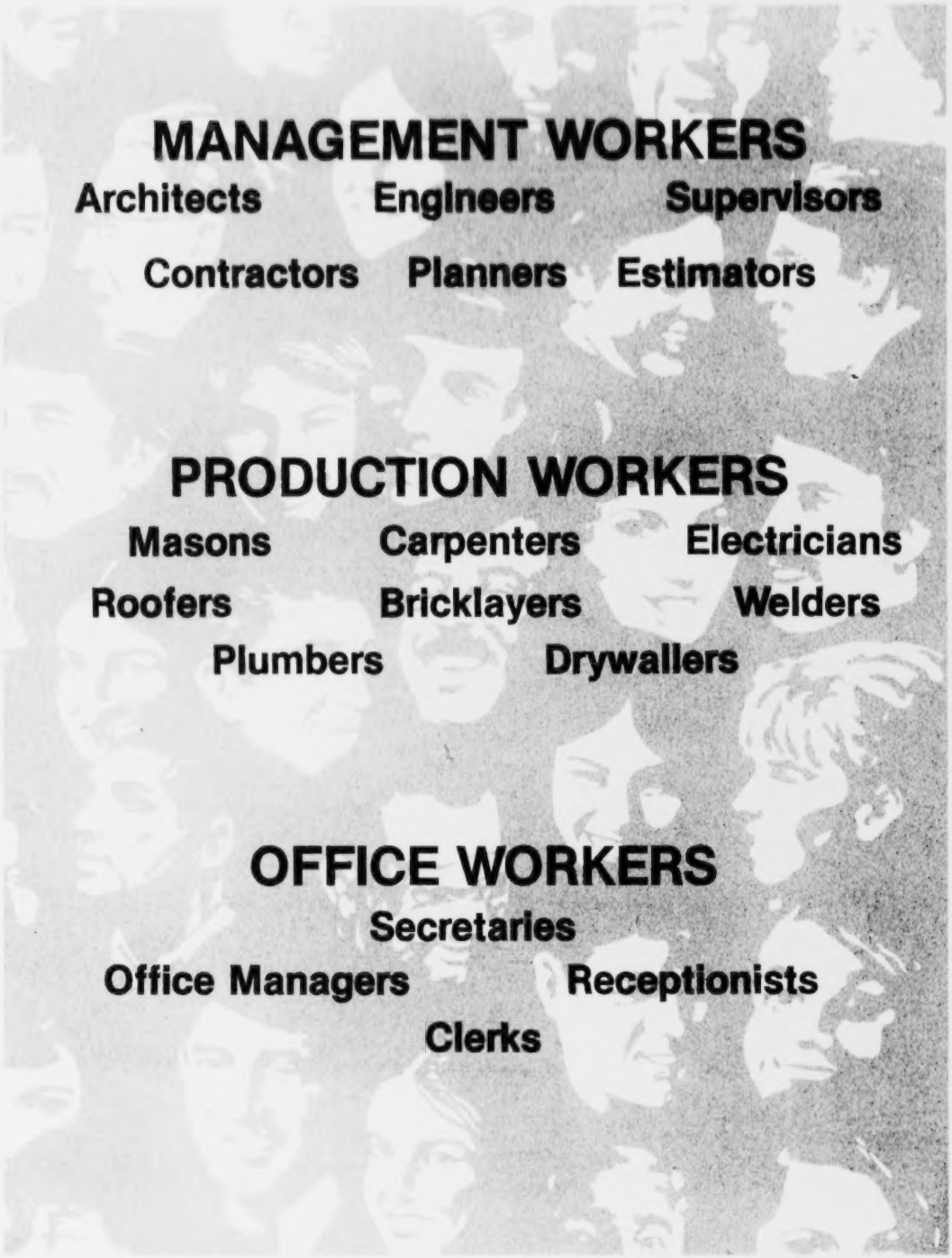
Preprocessing



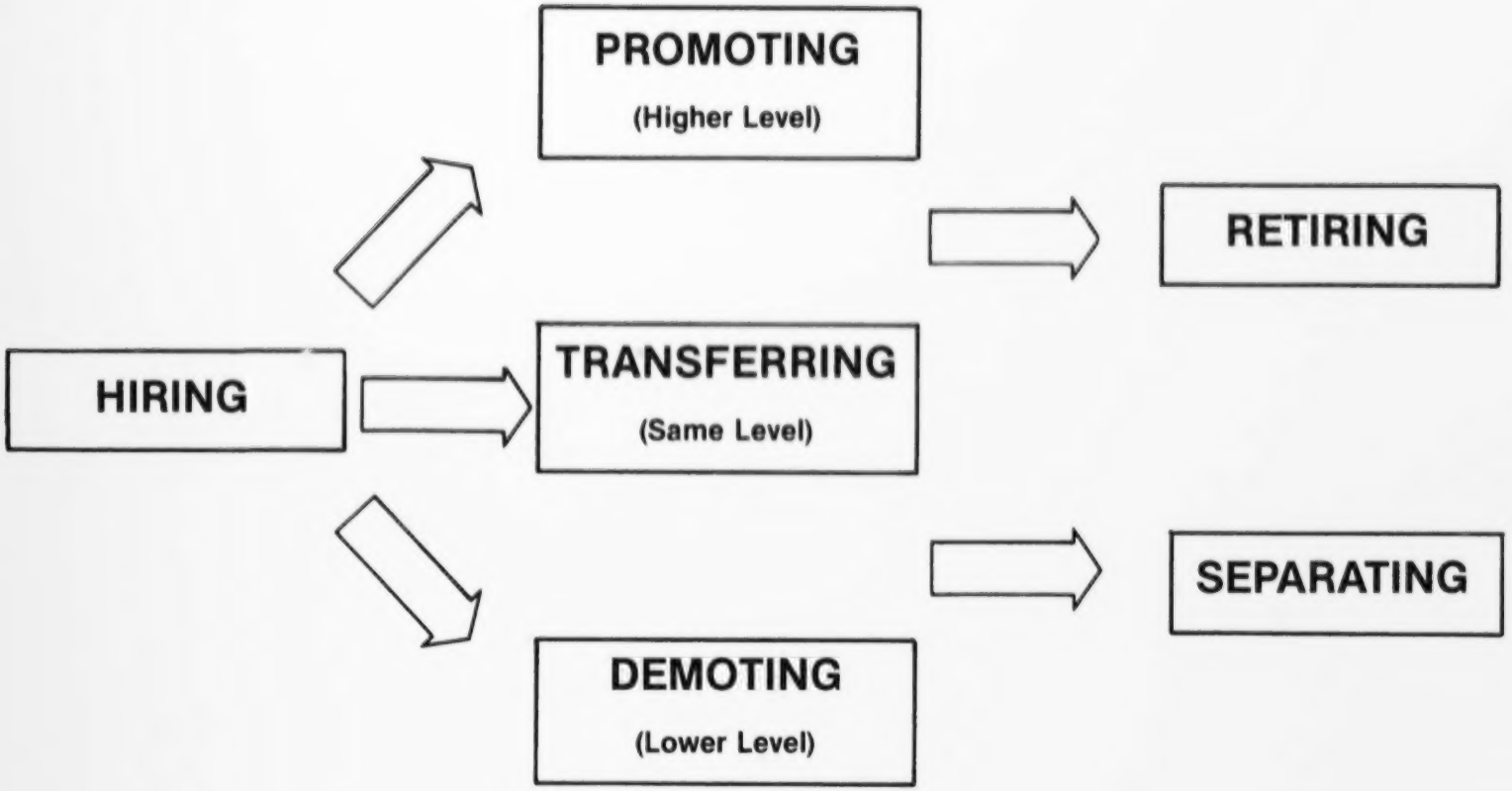
Processing

Postprocessing

Major Groups of Construction Workers



Personnel Practices



OVERVIEW OF CONSTRUCTION
UNIT I

HANDOUT #1 — EXECUTIVE PREVIEW OF AMERICA'S INFRASTRUCTURE

The nation's infrastructure is its system of public facilities, both publicly and privately funded, which provides for the delivery of essential services and a sustained standard of living. This interdependent, yet self-contained, set of structures provides for our mobility, shelter, services, and utilities. It is the nation's highways, bridges, railroads, and mass transit systems. It is our sewers, sewage treatment plants, water supply systems, and reservoirs. It is our dams, locks, waterways, and ports. It is our electric, gas, and power-producing plants. It is our courthouses, jails, firehouses, police stations, schools, post offices, and government buildings.

America's infrastructure is the base upon which society rests. Its condition affects our life-styles and security, and each is threatened by its unanswered decay.

America has no acceptable alternative to urgently developing a program to rebuild the nation's public facilities, the skeleton of public works that provides society's basic and supporting services.

The almost daily casualty list of failing public facilities includes highways, bridges, water supply systems, sewage treatment plants, pipelines, and dams. But beyond that, the victims of neglect include schools, utilities, parks, hospitals, libraries, firehouses, and jails. These facilities and services touch every aspect of everyone's life.

The presently identifiable program cost to meet presently identified needs is approximately $3 trillion, according to estimates compiled by The Associated General Contractors of America (AGC).

There can be no question about the national urgency. The problems are not merely serious. Many are beyond the point where deterioration begins to accelerate at alarming rates and the hazards begin to compound themselves. The percentages of facilities in serious decay suggest the brutal reality:

- Nearly half of the nation's bridges are too weak to adequately handle the traffic loads.
- Almost one of every two paved miles of road needs to be resurfaced or completely rebuilt.
- About 13 percent of the country's aging dams are classified as "high hazard."
- America's railroads must replace half of their ties over the next five years.
- Nearly half of the nation's sewage treatment plants are preventing economic growth because of inadequate capacity.
- Municipal water systems throughout the country are collapsing, threatening the quality of the water people consume, or failing to keep up with demand.

HANDOUT #1

While the cost of repairs is great, there is no alternative, and the cost of delay is too high. The alternative to meeting the challenge is a continued and rapidly increasing deterioration of the nation's economic base, in the quality of life, and in the public's health. The General Accounting Office, for example, sees drinking water contamination "emerging as one of the most serious health and environmental problems facing our nation during the '80s."

A public facilities renewal program will also provide immense benefit to the economy and increased employment. Unemployment, which has weakened the nation's workforce, has hit nearly one million persons in the construction industry, about one out of every five. Each $1 billion spent on construction creates tens of thousands of on-site jobs and has a multiplier effect in related industries and fields that benefit from construction spending. For example, $1 billion spent on rebuilding our nation's highways would generate 13,100 on-site jobs and 63,000 jobs overall.

The complexity and scope of the nation's crumbling public facilities are a crisis and an opportunity. The crisis, as it becomes increasingly clear, threatens in very direct ways the nation's health, its safety, its economy, its workers, and its ability to meet the needs of today and tomorrow.

The opportunity is equally clear. It is to revitalize the national delivery of the vital services its citizens demand and to put them on a sounder financial base.

The needs could not be clearer, or more immediate. The price of delaying the task increases the ultimate cost to everyone.

Source:"AGC/CIMC Instructional Systems and Executive Preview" by John Friedemann.

OVERVIEW OF CONSTRUCTION
UNIT I

ASSIGNMENT SHEET #1 — EVALUATE YOUR HOME

NAME _____ SCORE _____

Directions: Studying your own home will help you plan your "dream home." You will learn how large the rooms should be, how rooms should be grouped, and the cost of space. Use the following form and:

1. Compute and record on the form the amount of area in your home that is used for the following purposes: food preparation and eating, living and entertainment, quiet area, bathing, storage, and entries and halls. The measurements should be accurate to the nearest inch. Enter dimensions in column 2 and calculate square footage in column 3.

2. Rate the size of each room in your home in column 4 by entering one of the following:

   L = too large
   S = too small
   C = correct size

3. Discuss how your home meets your family's needs. What changes or additions are needed to meet those needs?

4. Find the average cost per square foot to build a home in your community, and calculate how much it would cost to build your present home today.

   (NOTE: Materials and labor cost is also a way to estimate construction cost.)

ASSIGNMENT SHEET #1

Size of Rooms in Your Home

1 Name of Room	2 Dimensions Width x Length	3 Area Sq. Ft.	Size Rating	Zones (Total Area)
1. Kitchen				Food Preparation and Eating
2. Dining Room				
3. Living Room				Living and Entertaining
4. Family Room				
5. Recreation Room				
6. Master Bedroom				Quiet Area
7. Bedroom 2				
8. Bedroom 3				
9. Bedroom 4				
10. Den/Study				
11. Bath 1				Bathing
12. Bath 2				
13. Utility Room				Storage
14. Storeroom				
15. Garage				
16. Foyer				Entries and Hallways
17. Hall 1				
18. Hall 2				
19. Stairwell				
Other (Specify)				
20.				
21.				
22.				
23.				
24.				
	Total Area:			

Size Rating
L = too large
S = too small
C = correct size

OVERVIEW OF CONSTRUCTION
UNIT I

JOB SHEET #1 — CONSTRUCT A SITE BOX

A. Materials and equipment

1. Bill of material

Quantity	Item	Size	Unit Cost	Cost
4 pcs	lumber	1 × 3 × 48″		
1 pc	plywood	1/2″ × 48″ × 48″		
1 roll	masking tape	3/4″		
30	common nails	6d		

2. Equipment

1 claw hammer per team
1 square

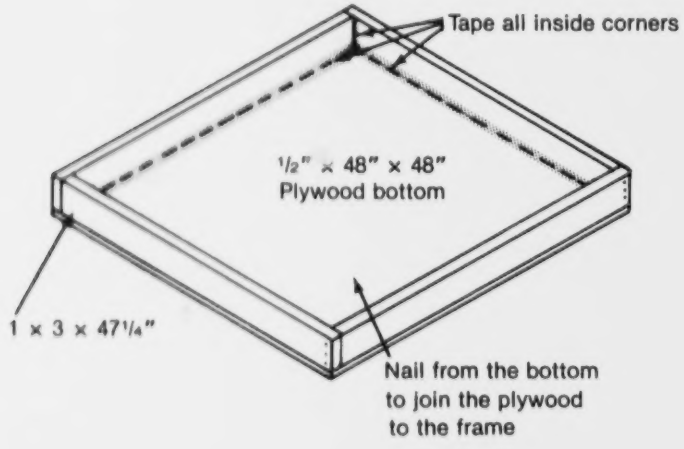
B. Procedure

(NOTE: Work as a group or as directed by your instructor. This site box will be used throughout the construction course to assist in performing certain tasks.)

1. Obtain equipment and supplies.

2. Construct the site box as shown.

FIGURE 1



JOB SHEET #1

3. Seal corners inside the box with the masking tape.
4. Return all equipment and supplies to proper storage.
5. Clean the work area.

OVERVIEW OF CONSTRUCTION
UNIT I

PRACTICAL TEST
JOB SHEET #1 — CONSTRUCT A SITE BOX

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials	_____	_____
2. Worked well on assigned duties	_____	_____
3. Worked as a team member	_____	_____
4. Produced a site box	_____	_____
5. Checked in/put away tools and materials	_____	_____
6. Cleaned the work area	_____	_____
7. Used proper tools correctly	_____	_____
8. Performed steps in a timely manner (__hrs. __min. __sec.)	_____	_____
9. Practiced safety rules throughout procedure	_____	_____
10. Provided satisfactory responses to questions asked	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Corners of box are square				
	4	3	2	1
Inside corners are properly sealed				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately Skilled — Has performed job during training program; limited additional training may be required. 2 — Limited Skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

OVERVIEW OF CONSTRUCTION
UNIT I

NAME _____ SCORE _____

TEST

1. Match the terms on the right with the correct definitions.

_____a.	A complaint made by laborers when they feel the management has acted unfairly	1. AFL-CIO
_____b.	System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living	2. Arbitration
_____c.	A last resort effort used by the union to force management to bargain	3. Construction industry
_____d.	The hearing and deciding of an issue in controversy by a person chosen by both sides	4. Grievance
_____e.	A national labor group representing different kinds of workers	5. Infrastructure
_____f.	Parts manufactured in a factory and shipped to the building site so that parts only need to be assembled or united at the site	6. Modules
_____g.	Units constructed with standardized dimensions for flexibility and variety in use	7. Negotiation
_____h.	Discussion between labor and management to settle differences	8. Prefabricated units
_____i.	A managed production system that exists to build and service infrastructures that meet the needs of society	9. Strike

TEST

2. Distinguish between the major types of construction by placing the appropriate letters next to the correct descriptions.

   - CI — Civil or heavy construction
   - CO — Commercial construction
   - R — Residential or light construction

   _____a. Concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings

   _____b. Primarily involved with the erection of commercial, industrial, educational, and institutional buildings

   _____c. Includes railroads, earth-moving projects, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities

3. Match the resources used in construction on the right with the correct descriptions.

   _____a. People who plan, organize, direct, and control the work

   _____b. Natural resources and manufactured products

   _____c. People who operate the equipment and use the materials

   _____d. Implements and tools

   _____e. Systematic procedures and techniques used in building

   1. Equipment
   2. Management
   3. Materials
   4. Methods
   5. Workers

4. Distinguish between the steps in producing constructed works by placing the following letters in the correct blanks.

   - PRE — Preprocessing
   - PRO — Processing
   - POST — Postprocessing

   _____a. Includes separating, combining, and forming of material to produce a structure.

   _____b. Includes installing, maintaining, repairing, or altering the equipment or structure.

   _____c. Includes receiving, handling, storing, and protecting materials and the site prior to construction.

TEST

5. Match major groups of construction workers with the correct descriptions.

_____a.	Plan, organize, and control production systems. There are many kinds and levels. They include community planners, estimators, contractors, supervisors, architects, and engineers.	1. Management workers 2. Office workers 3. Production workers
_____b.	Carry out the plans of management. They do the onsite work. They have many different specialties including bricklayers, electricians, plumbers, and carpenters.	
_____c.	Perform office tasks much like that done in any office. They include receptionists, secretaries, clerks, and accountants.	

6. Match the education and training required on the right with the correct groups of construction workers.

_____a.	Usually complete high school, vocational school, or college business and office training programs.	1. Management workers 2. Office workers 3. Production workers
_____b.	Usually have 4-5 years of college education in engineering, architecture, or construction management.	
_____c.	Usually are trained in a classroom and on the job through apprenticeship programs by working with skilled workers.	

7. Match construction job titles on the right with the correct descriptions.

(NOTE: Job titles may be used more than once.)

_____a.	Contract to perform specified construction work in accordance with architect's plans, blueprints, codes, and other specifications.	1. Architect, designer, engineer 2. Contractor, subcontractor 3. Construction superintendent 4. Construction inspector 5. Construction worker
_____b.	Performs any combination of duties on construction projects, usually working in utility capacity, by transferring from one task to another task where demands require workers with varied experience.	
_____c.	Plan layout of project and integrate engineering elements into unified design.	
_____d.	Estimate costs of materials, labor, and use of equipment required to fulfill provisions of contract; prepare bids.	

TEST

_____e. Manages projects that range in cost from a few thousand dollars to several million.

_____f. Directs the workers, and keeps track of schedules, budgets, methods, and procedures.

_____g. Consult with clients to determine size and space requirements and provide information regarding cost, design, materials, equipment, and estimated building time.

_____h. Inspects and oversees construction to assure quality.

_____i. Provide professional services in research, development, design, construction, alteration, or repair of real property.

8. Match personnel practices in construction on the right with the correct descriptions.

_____a. Moving to a higher level job

_____b. Finding and attracting needed employees

_____c. Withdrawing from an occupation at the end of a career

_____d. Moving to a different job; usually at the same level and pay

_____e. Moving to a lower level job

_____f. A screening process for choosing the best qualified person from among those who applied for the job

_____g. Programs designed to make new employees feel that they belong and to help them learn how to do their jobs as a team member

_____h. Firing, relocating, and laying off workers

1. Demoting
2. Inducting
3. Promoting
4. Recruiting
5. Retiring
6. Selecting
7. Separating
8. Transferring

TEST

9. Select true statements concerning labor/management practices by placing an "X" next to the true statements.

   _____a. Workers have to vote for a union.

   _____b. Unions act as bargaining agents for workers.

   _____c. Labor contracts usually deal with what type of products may be produced and what tools may be used.

   _____d. Collective bargaining is the process of union leaders working with company management leaders to discuss and decide issues.

10. Complete statements concerning construction and the future by filling in the blanks.

    a. A challenge for the future of construction is _____

    _____

    _____

    _____

    b. Name one way construction has tried to meet the challenges.

    _____

    _____

    _____

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Evaluate your home. (Assignment Sheet #1)

12. Demonstrate the ability to construct a site box. (Job Sheet #1)

OVERVIEW OF CONSTRUCTION
UNIT I

ANSWERS TO TEST

1. a. 4
   b. 5
   c. 9
   d. 2
   e. 1
   f. 8
   g. 6
   h. 7
   i. 3

2. a. R
   b. CO
   c. CI

3. a. 2
   b. 3
   c. 5
   d. 1
   e. 4

4. a. PRO
   b. POST
   c. PRE

5. a. 1
   b. 3
   c. 2

6. a. 2
   b. 1
   c. 3

7. a. 2
   b. 5
   c. 1
   d. 2
   e. 3
   f. 3
   g. 1
   h. 4
   i. 1

8. a. 3
   b. 4
   c. 5
   d. 8
   e. 1
   f. 6
   g. 2
   h. 7

9. a, b, d

10.-12. Evaluated to the satisfaction of the instructor

CONSTRUCTION SAFETY
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the correct attitude toward safety and exhibit safe work practices in construction. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum of 100 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Discuss laboratory and site safety.
2. Discuss personal safety practices.
3. Complete statements concerning housekeeping practices.
4. Identify basic types of ladders.
5. Select true statements concerning correct ladder use.
6. List rules for using common portable power tools.
7. Complete statements concerning general safety for portable power tools.
8. Complete a safety pledge. (Assignment Sheet #1)
9. Survey laboratory facilities. (Assignment Sheet #2)
10. Identify unsafe construction practices. (Assignment Sheet #3)
11. Complete a word search of safety terms. (Assignment Sheet #4)

CONSTRUCTION SAFETY
UNIT II

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included in this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

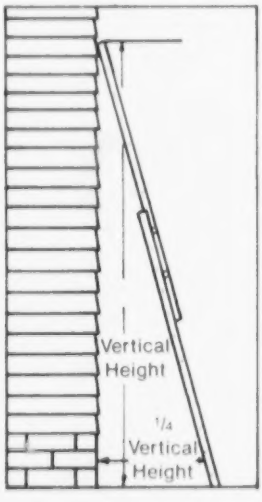
E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit:

1. Discuss the hand and power tools that are unique to your laboratory activity.

2. Discuss and demonstrate ladder pitch or angle. The horizontal distance at the bottom should be one-fourth the vertical distance of the ladder.



3. Discuss the correct use of scaffolds and guardrails.

4. Use the film *An Option to See, It's Up to You*, or other eye safety films to stress the importance of using eye protection.

5. Show unsafe tools or equipment and have students identify the problems.

6. Discuss OSHA, ANSI, and other regulatory acts and agencies.

SUGGESTED ACTIVITIES

7. Have students locate and read the labels on each of the fire extinguishers in the laboratory area, listing the class or classes of fire each should be used on.

8. Stress the consequences of practical jokes in the laboratory or on the construction site.

9. Explain how horseplay around power equipment increases the possibility of accidents.

10. Use the student pledge or contract to reinforce safety practices. (Assignment Sheet #1)

11. Use a student progress chart for recordkeeping.

12. Make safety instruction an integral part of your instruction. Set proper safety examples for the students to follow.

13. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

14. Plan to implement the Circuit Buster Safety System in your program. Contact Paxton/Patterson, 5719 West 65th Street, Chicago, IL 60638 for cost and other information.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Feirer, John L. and Gilbert R. Hutchings. *Guide to Residential Carpentry.* Peoria, IL: Bennett Publishing Company, 1983.

B. *Accident Prevention for Industrial Arts Vocational and Technical Education Programs.* Stillwater, OK: Oklahoma State Board of Vocational and Technical Education.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Housekeeping Means Safe Keeping.* Color, 10 minutes
Journal Films, Inc.
930 Pitner Avenue
Evanston, IL 60202

(NOTE: This film begins by taking the audience to a typical plant where they are presented with a variety of housekeeping violations. The dangers of these violations are then forcefully dramatized in the slow-motion recreation of a painful and realistic accident.)

SUGGESTED SUPPLEMENTAL RESOURCES

2. *Stop a Fire Before It Starts.* Color, 10 minutes
Journal Films, Inc.
930 Pitner Avenue
Evanston, IL 60202

(NOTE: In easy-to-understand laboratory demonstrations, this film shows how everyday materials become explosive in the presence of sparks, cigarettes, and so on. From the laboratory, the film moves to typical on-the-job locations where hazardous fire situations are encountered and their blazing conclusions displayed. Most importantly, viewers learn why these situations were hazardous and what could have been done to prevent these fires.)

3. *A New Way to Lift.* Color, 9 minutes
Journal Films, Inc.
930 Pitner Avenue
Evanston, IL 60202

(NOTE: This film, produced in conjunction with the National Safety Council, demonstrates body mechanics that apply to all lifting situations. By following these tips, students may avoid serious back injury.)

4. *The Industrial Weightlifter II.* Color, 11 minutes
International Film Bureau, Inc.
332 South Michigan Avenue
Chicago, IL 60604

(NOTE: Visuals have been updated that illustrate correct techniques for lifting heavy objects to prevent injury.)

5. *An Option to See.* Color, 18 minutes
Film Library
Oklahoma State Department of Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, OK 74074-4364

(NOTE: This safety film stresses the importance of wearing safety glasses while working around machinery.)

6. *Don't Push Your Luck.* Color, 12 minutes
Harvest Films, Inc.
309 Fifth Avenue
New York, NY 10016

(NOTE: In this film Bill Frank, an actual victim, recreates his real-life blinding accident. He delivers powerful safety messages to industrial employees and shows proper eye and face protection.)

7. *It's Up to You.* Color, 11 minutes
Harvest Films, Inc.
309 Fifth Avenue
New York, NY 10016

(NOTE: This is an award-winning film on eye safety.)

SUGGESTED SUPPLEMENTAL RESOURCES

8. *Eye Injuries*. Color, 6 minutes
International Film Bureau, Inc.
332 South Michigan Avenue
Chicago, IL 60604

(NOTE: This film demonstrates the procedure for removing particles from under the eyelids.)

9. *On Every Hand*. Color, 10 minutes
Journal Films, Inc.
930 Pitner Avenue
Evanston, IL 60202

(NOTE: This film demonstrates how to avoid serious hand injuries that could be caused by commonly used and dangerous equipment.)

10. *How to Avoid 16 Leading Causes of OSHA Citations*. Color, 20 minutes
Bureau of Business Practice
24 Rope Ferry Road
Waterford, CT 06386

(NOTE: This film shows the most common OSHA violations and tells how to avoid them.)

11. *Safety in the Shop: Basic Practices*. Black and white, 13 minutes
Coronet Films
65 East South Water Street
Chicago, IL 60601

(NOTE: This film emphasizes the worker's responsibility for safety in using hand and power tools. It explains the importance of a clean shop, proper clothing, correct ways to lift, and ways to guard against fires.)

12. *Danger Zone: Your Back*. Color, 18 minutes
Visucom Productions
P.O. Box 5472
Redwood City, CA 94063

(NOTE: This safety film demonstrates good lifting, pulling, and pushing practices and is designed to motivate employees to participate in accident prevention.)

B. Safety signs, posters, and other films or filmstrips

(NOTE: Various safety educational materials and filmstrips are available from Underwriters Laboratories, Inc., Public Information and Education Services, 207 East Ohio Street, Chicago, IL 60611.)

SUGGESTED SUPPLEMENTAL RESOURCES

C. Full-color transparencies from the unit "Fire Behavior" in the IFSTA manual *Essentials of Fire Fighting*

(NOTE: This box of seventeen transparencies covering the burning process includes a plastic universal mount and an interleaf of each transparency for use by the instructor in a teaching outline. This set of transparencies is available from Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, or call toll-free 800-654-4055.)

D. Competency profiles, laboratory safety signs, and safety posters

(NOTE: Competency profiles, laboratory safety signs, and safety posters for this book are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, OK 74074, or call toll-free 800-654-4502.)

CONSTRUCTION SAFETY
UNIT II

INFORMATION SHEET

I. **Laboratory and site safety** (Transparencies 1-3)

A. Always walk — do not run.

B. Never talk to or interrupt anyone who is working on power tools or machines.

C. Unplug or turn off power supply to a machine or portable equipment when changing cutters or blades.

D. Never leave tools or pieces of stock lying on the table surface of a machine being used.

E. When finished with a machine, turn off the power and wait until the blade or cutter has come to a complete stop before leaving.

F. Always carefully check stock for knots, splits, metal objects, and other defects before machining.

G. Do not use a machine until you understand it thoroughly.

(NOTE: Any tool with a sharp cutting edge can cause serious injury if mishandled.)

H. Use guards on power equipment.

(NOTE: It should be understood that using guards does not necessarily prevent accidents. Guards must be used correctly if they are to provide fullest protection. Also, it is impossible to do some operations, especially on the circular saw, with the regular guard in place. Therefore there are times when special guards should be used.)

I. Always keep your fingers away from the moving cutting edges.

(NOTE: The most common accident is caused by trying to run too small a piece through a cutting machine, which can allow your fingers to get too close to the blades.)

J. Keep the floor around the machine clean. The danger from falling or slipping is always great.

K. Make all adjustments with the power off and the machine at a dead stop.

L. Always use a brush to clean the table surface.

M. Always keep your eyes focused on where the cutting action is taking place.

N. Keep cord out of path of cutting edge.

INFORMATION SHEET

O. Always use sharp tools.

(NOTE: More accidents are caused by using dull tools than by using properly sharpened tools.)

P. When using tools for set-up work on a machine:

1. Select the right tool for the job.
2. Keep it in safe condition.
3. Keep it in a safe place.

Q. Report strange noises or faulty operation of machines to the instructor.

R. Follow the instructions for each machine given by your instructor.

II. Personal safety

A. Dress

1. Wear protective equipment as required. (Transparencies 4 and 5)

   Examples: Safety glasses, goggles, hard hats, ear protection, gloves, steel-toed shoes, face shields

2. Clothing should suit your individual needs.

   (NOTE: Avoid improperly fitting clothing that would restrict freedom of movement.)

3. Clothing worn in the laboratory or on the job site should be acceptable for the activity.

   (NOTE: If possible when you enter the lab each day, exchange your regular clothing for coveralls or lab coats.)

4. Avoid wearing pants or overalls that are too long. Cuffs made by turning up the legs of pants tend to catch heels, causing falls.

5. To avoid catching on nails, keep the sleeves of shirts or jackets buttoned.

6. Keep hair cut short or keep long hair secured safely.

7. To protect feet from protruding nails, wear shoes with thick, sturdy soles.

8. Wear a hard hat when exposed to overhead work or whenever there is danger from falling objects.

9. Remove neckties, rings, wristwatches, neck chains, and other jewelry.

INFORMATION SHEET

B. Material handling

1. Long pieces of material should be carried by two people.

2. Use the muscles in your legs and knees to lift heavy objects. Do not lift with your back muscles. (Transparency 6)

   (NOTE: To do so could result in painful back injuries.)

3. Observe caution when carrying planks or other objects across frozen, wet, or otherwise slippery footing.

   (CAUTION: Avoid falls, watch your footing, avoid objects that can trip you. Check scaffolding and ladders before using them.)

III. Housekeeping practices

A. Materials and equipment should be stacked straight and neat.

B. Keep aisles and walkways clear of tools, materials, and debris.

C. Dispose of scraps and rubbish daily to prevent fires and reduce hazards which cause accidents.

D. Whenever you see protruding nails, remove them or bend them down immediately.

E. When working above other people, place tools and materials where they will not fall and cause injuries.

IV. Basic types of ladders

A. Folding

B. Extension

INFORMATION SHEET

C. Straight

V. **Correct ladder use** (Transparency 7)

A. Inspect ladders carefully. Keep nuts, bolts, and other fastenings tight. Do not allow makeshift repairs. Never straighten or use a bent metal ladder.

B. Ladders must stand on a firm, level surface. Always use safety feet with nonslip bases.

C. Face the ladder when climbing up or down.

D. Always place the ladder close enough to the work to avoid dangerous overreaching.

E. Keep your weight centered between both side rails.

F. Keep steps and rungs free of oil, grease, paint, or other slippery substances.

G. Be sure that stepladders are fully open and that the spreader is locked in place.

H. Never stand or climb on the top, pail rest, or rear rungs of a folding stepladder.

I. Never place ladders in front of doors or openings unless appropriate precautions are taken.

J. Be sure all locks on extension ladders are securely hooked over rungs before climbing. Adjust the height of an extension ladder only when standing at the base of the ladder.

K. Metal and water conduct electricity. *Do not use metal, metal reinforced, or wet ladders where direct contact with a live power source is possible.*

L. A ladder is intended to carry only one person at a time. Do not overload.

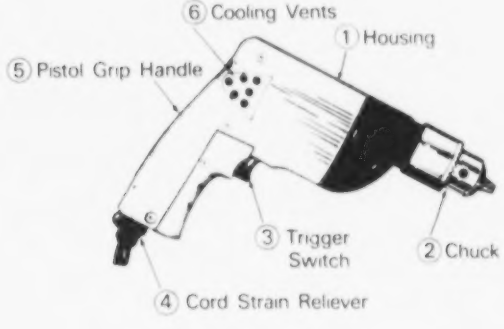
M. Never use ladders in a horizontal position.

INFORMATION SHEET

VI. Rules for using common portable power tools

A. Portable electric drill — Used for drilling, boring, and installing wood screws

1. Make certain drill bit is securely gripped in chuck.
2. Check to see that key is removed from chuck before starting.
3. Drill with steady, even pressure. Let the drill do the work.

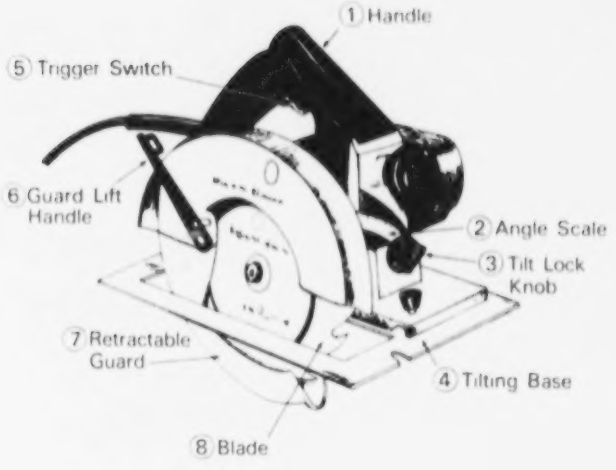


B. Portable power saw — Used for all types of cutting

1. Make sure blade is the proper type for the work to be done.
2. Make sure blade is properly installed and the arbor nut is tight.
3. Make certain that work to be cut is firmly supported, clamped, and free of obstruction.
4. Check to see if the blade guard is functioning before connecting power source.

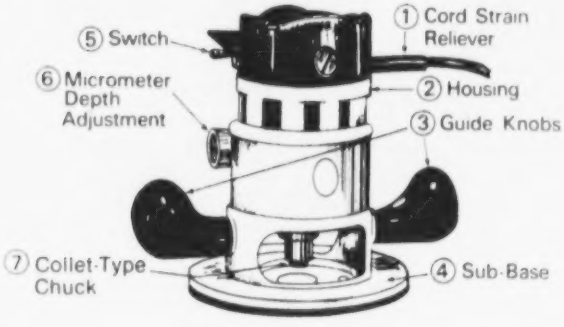
   (**CAUTION:** Make sure hands and cords are out of the path of the cutting edge.)

INFORMATION SHEET



C. Portable router — Used for shaping the edges and surfaces of stock

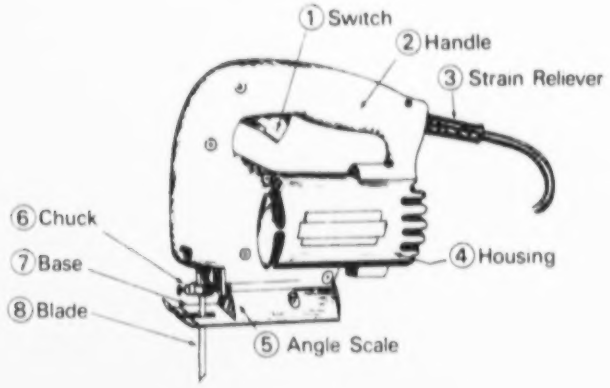
1. Select proper router bit for the work to be done.
2. Make a trial cut on a piece of scrap lumber.
3. Keep cutting pressure constant; do not overload router.



INFORMATION SHEET

D. Saber saw — Used for on-the-job cutting of irregular shapes

1. Make sure the blade is correct for the job to be performed and tightly clamped in chuck.
2. Use clamps or vises to hold material to be cut.
3. Always hold the saw base tightly against material to be cut.

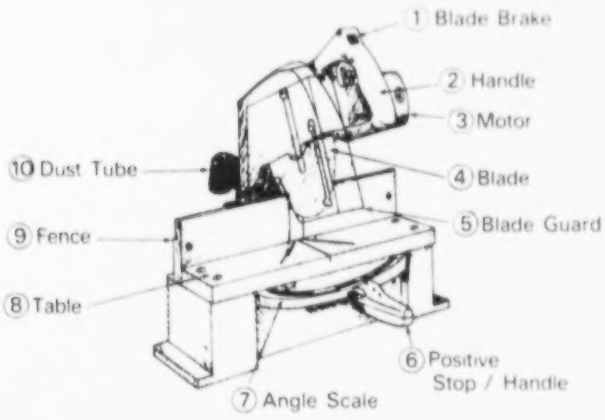


E. Motorized miter box — Used for cutting miters and for fitting and installing molding

1. Always hold the work firmly against the fence and table.
2. Install a new table if adequate support has been cut away.
3. Allow motor to reach full speed before starting to cut.
4. Use the brake to stop the blade before removing scrap or chips from the work area.
5. Do not attempt to cut oversized stock.
6. Enlist a helper to support end of long stock.

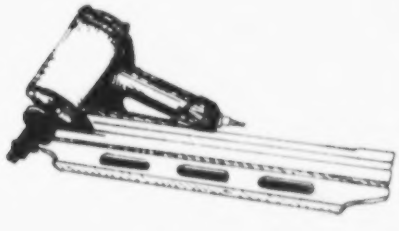
INFORMATION SHEET

7. Turn off motor immediately after making cut.

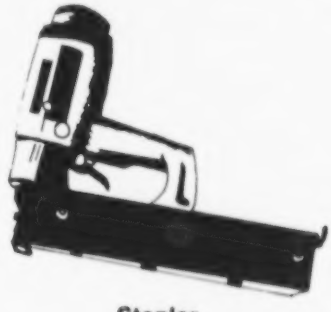


F. Pneumatic fasteners (stapler and nailer) — Used to apply sheathing, decking, framing, and roofing

1. Use pressure specified by manufacturer.
2. Use only nails or staples designed for fastener being used.
3. Use caution when attaching fastener to air supply because fastener may discharge.
4. Keep hands and body away from discharge end of fastener.
5. Do not discharge fasteners except when actually nailing or stapling.
6. Never point fasteners at anyone!
7. Never use fasteners on soft or thin material that nails may go through.



Nailer



Stapler

INFORMATION SHEET

VII. General safety for portable power tools

A. Never use portable power tools in contact with water, including rain, or if any part of your body is in contact with moisture.

(NOTE: Be sure the power plug is removed before making any adjustments.)

B. Portable power tools should be properly grounded with a three-prong grounded plug.

(NOTE: If a grounded receptacle is not available, use a three-to-two prong adapter plug which has been **properly** grounded.)

C. Always wear approved eye protection and other safety protection as needed. (Transparency 4)

D. Be sure the switch is in the "off" position before connecting the power plug.

E. Make sure cutting edges are sharp and ready to be used.

F. Always use the recommended extension cord size.

G. Operate power tools only after receiving instruction and completing test over that tool.

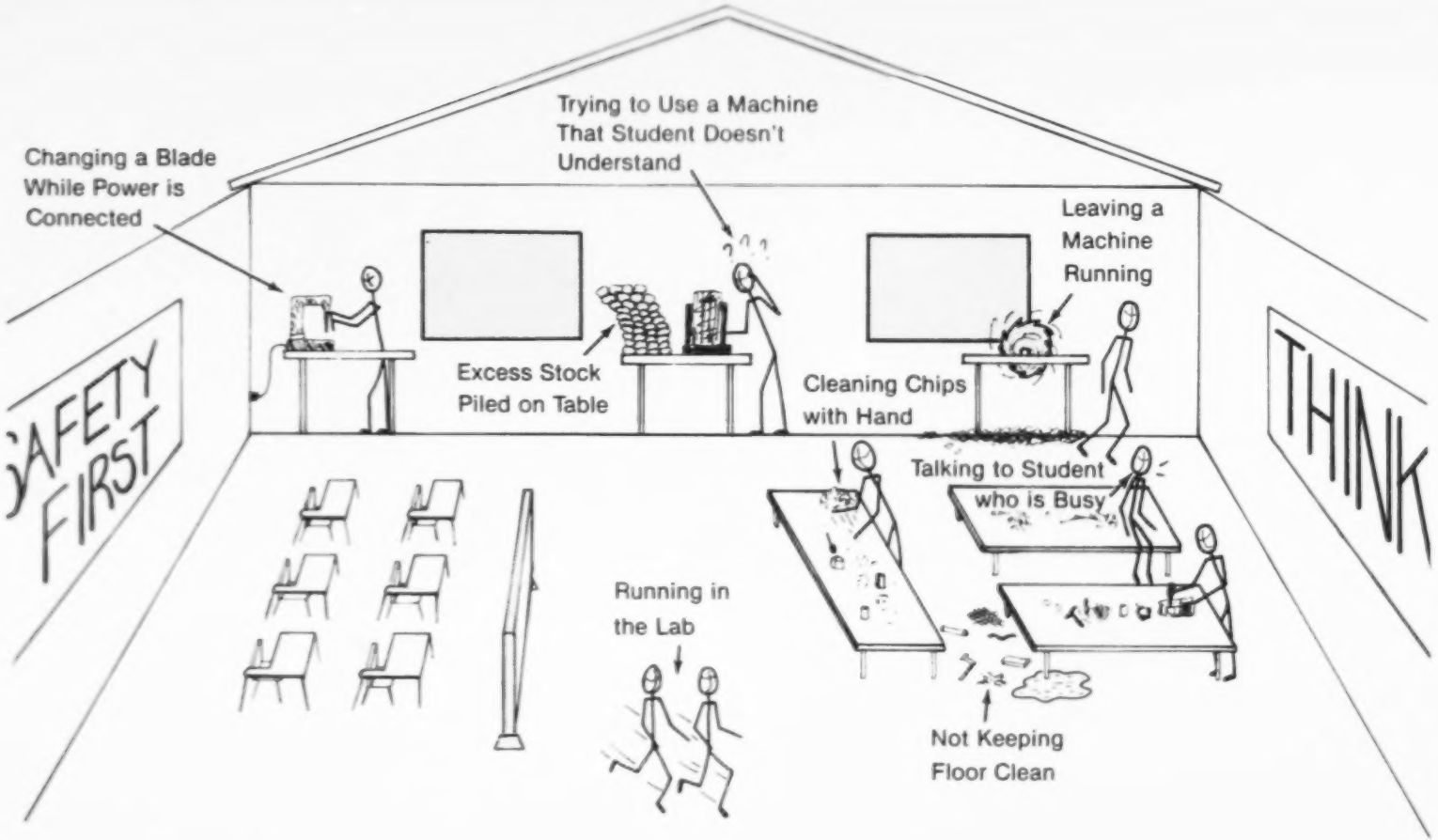
H. Operate power tools only with instructor's permission.

I. Make sure blades have come to a complete stop before leaving power tools.

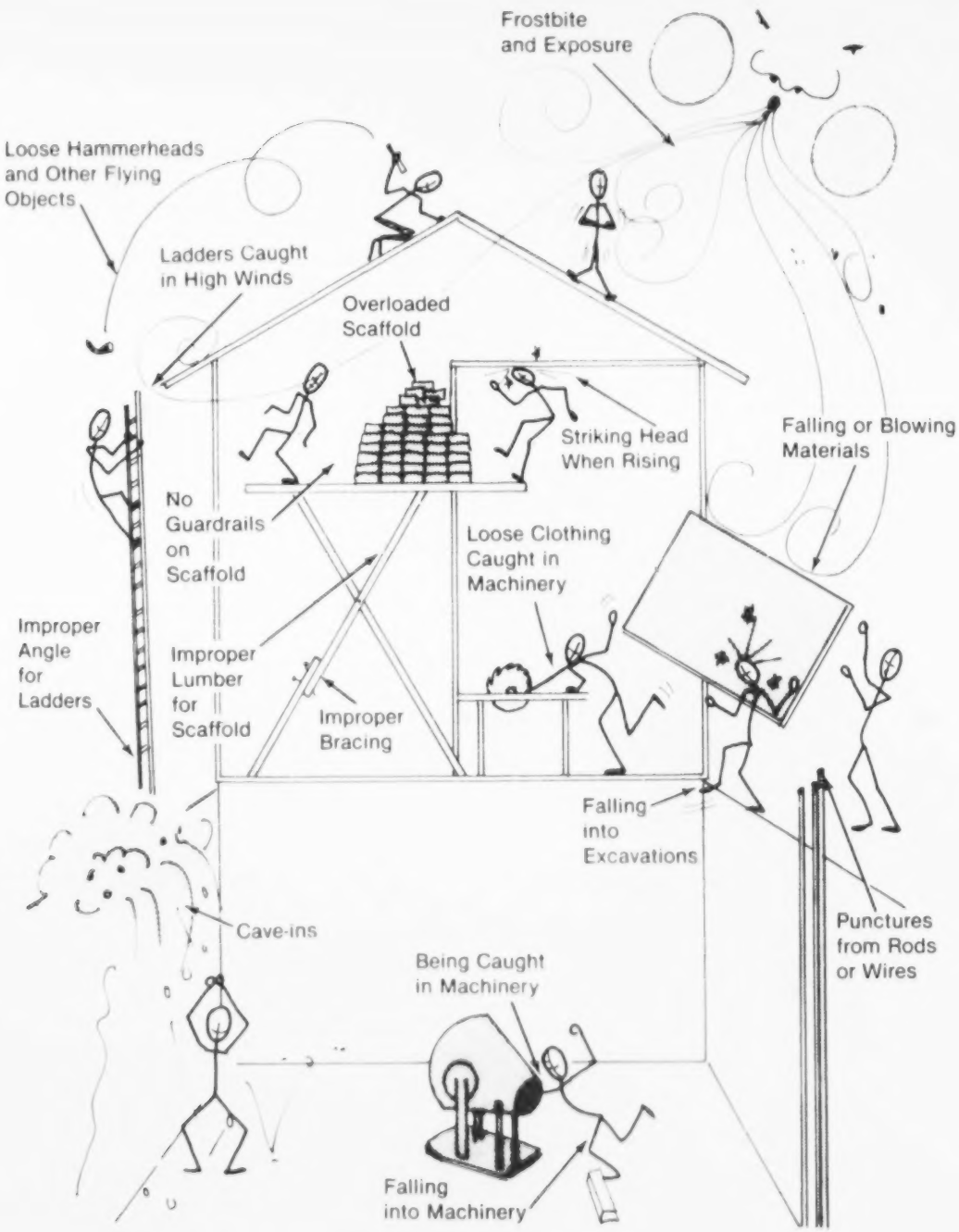
J. Always disconnect the power plug when the work is completed.

(NOTE: Equipment used in each laboratory and on each project will differ. Follow your instructor's direction for hand and power tool use.)

Safety Hazards in the Lab

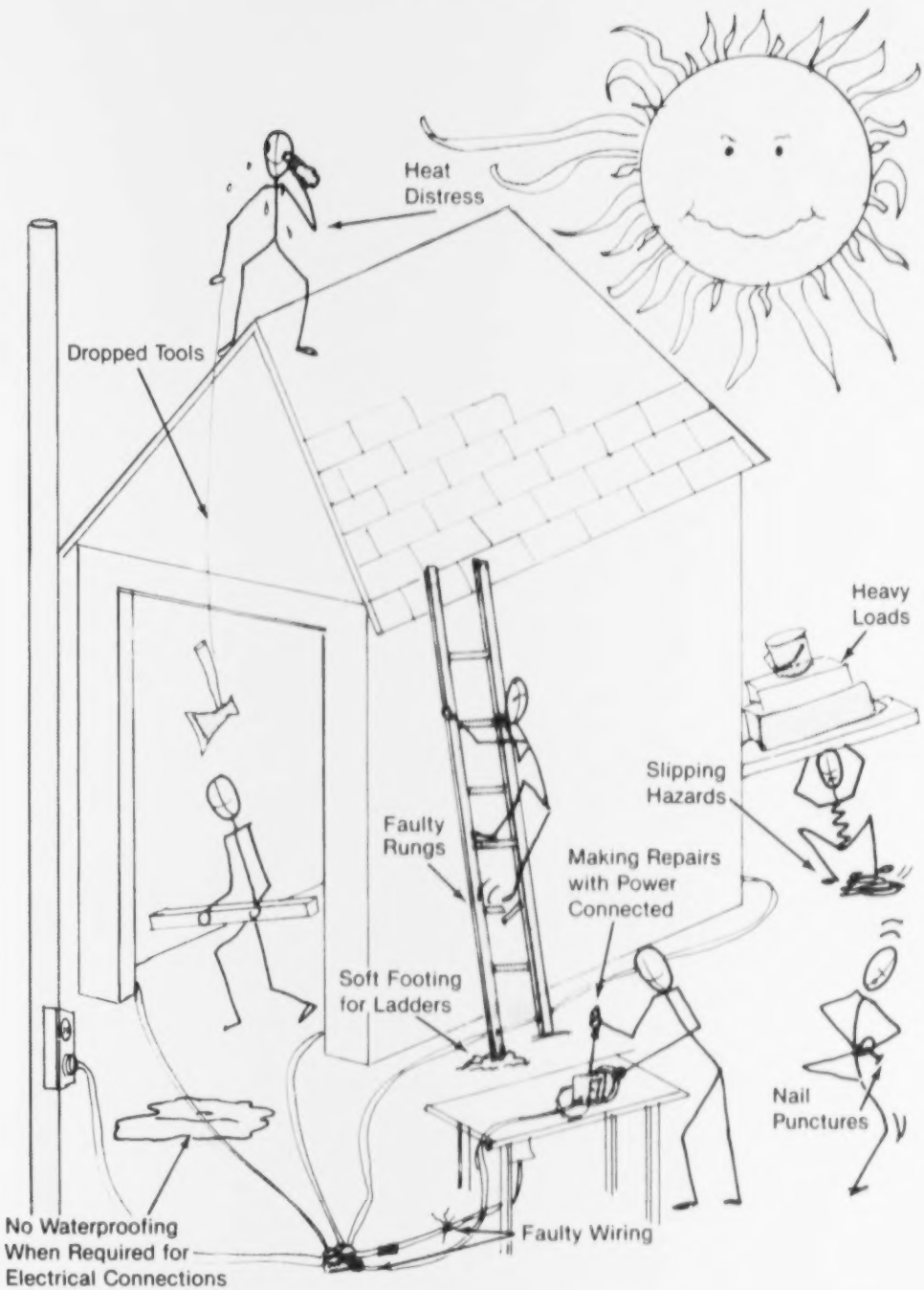

Changing a Blade While Power is Connected
Trying to Use a Machine That Student Doesn't Understand
Leaving a Machine Running
SAFETY FIRST
Excess Stock Piled on Table
Cleaning Chips with Hand
Talking to Student who is Busy
THINK
Running in the Lab
Not Keeping Floor Clean

Safety Hazards at the Site



Safety Hazards at the Site

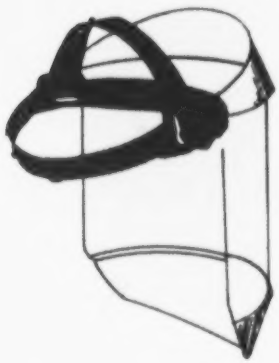
(Continued)



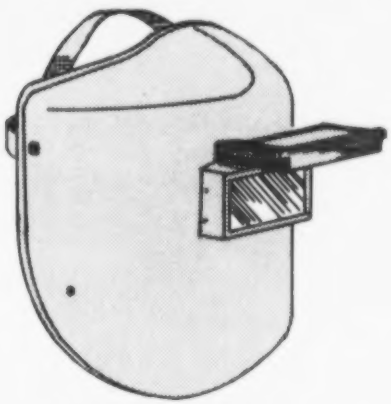
Safety Equipment

Safety Glasses
(with Sideshields)

Safety Goggles
(perforated frames)



Face Shield



Welding Helmet

Gloves

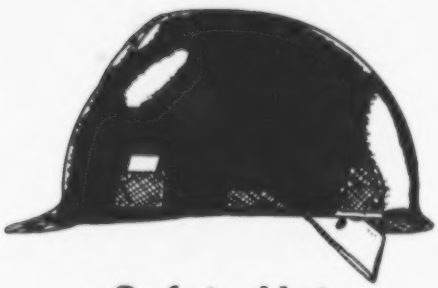
Safety Equipment

(Continued)

Ear Plugs

Ear Muffs

Hearing Protection

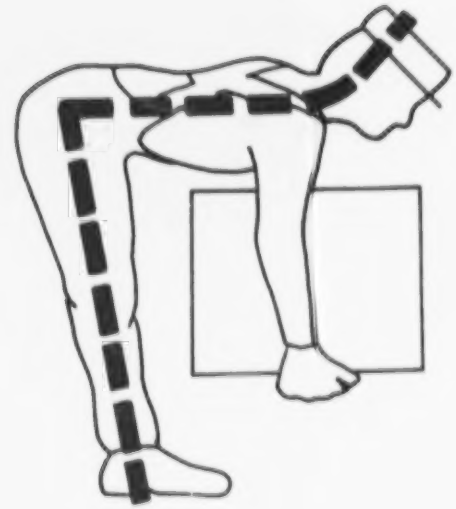


Safety Hat

Steel-Toed Safety Shoes and Boots

How to Lift Safely

LIFT THIS WAY



NOT THIS WAY

Proper Use of a Ladder

Check for broken or unsafe parts

Ladder ¼ length from wall

Use both hands

Never stand on top rungs

Open stepladder fully

Face ladder when going up or down—never jump off

Only one person on a ladder

CONSTRUCTION SAFETY
UNIT II

ASSIGNMENT SHEET #1 — COMPLETE A SAFETY PLEDGE

NAME _____ SCORE _____

Safety Pledge

It is understood that each student will be given proper instruction in the use of the equipment and in the correct safety procedures concerning the equipment before she or he will be allowed to operate it. The student must assume responsibility for following safe practices. We, therefore, ask that the student subscribe to the following safety pledge.

I will follow all safety rules.

I will never use a machine without first having permission from my instructor or supervisor.

I will not ask permission to use a particular machine unless I have been instructed in its use and have scored 100 percent on the safety test for that machine.

I will report immediately any accident or injury, no matter how minor, to instructor or supervisor.

Student's signature_____ **Date**_____

Instructor's signature_____ **Date**_____

Parent's or guardian's signature_____ **Date**_____

CONSTRUCTION SAFETY
UNIT II

ASSIGNMENT SHEET #2 — SURVEY LABORATORY FACILITIES

NAME _____ SCORE _____

Directions: Work as a team or individually as directed by your instructor to make a list of available tools and power equipment that will be utilized during the construction class. Make a note of safety equipment or procedures needed when in use. Is there a need to improve equipment for safety reasons?

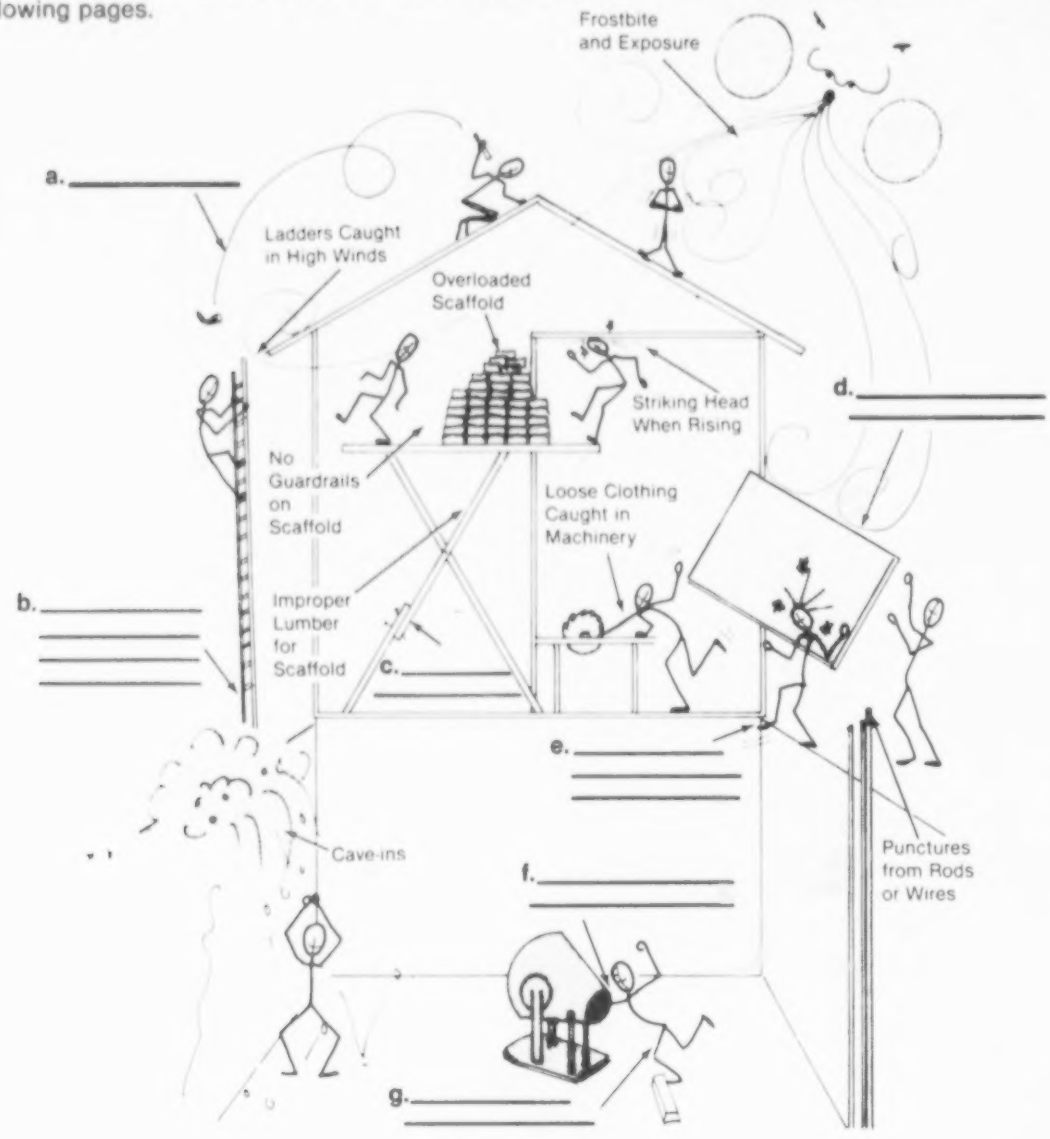
Tool or Equipment	Safety Procedure	Changes to Improve
Example: Claw hammer	eye protection	none
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

CONSTRUCTION SAFETY
UNIT II

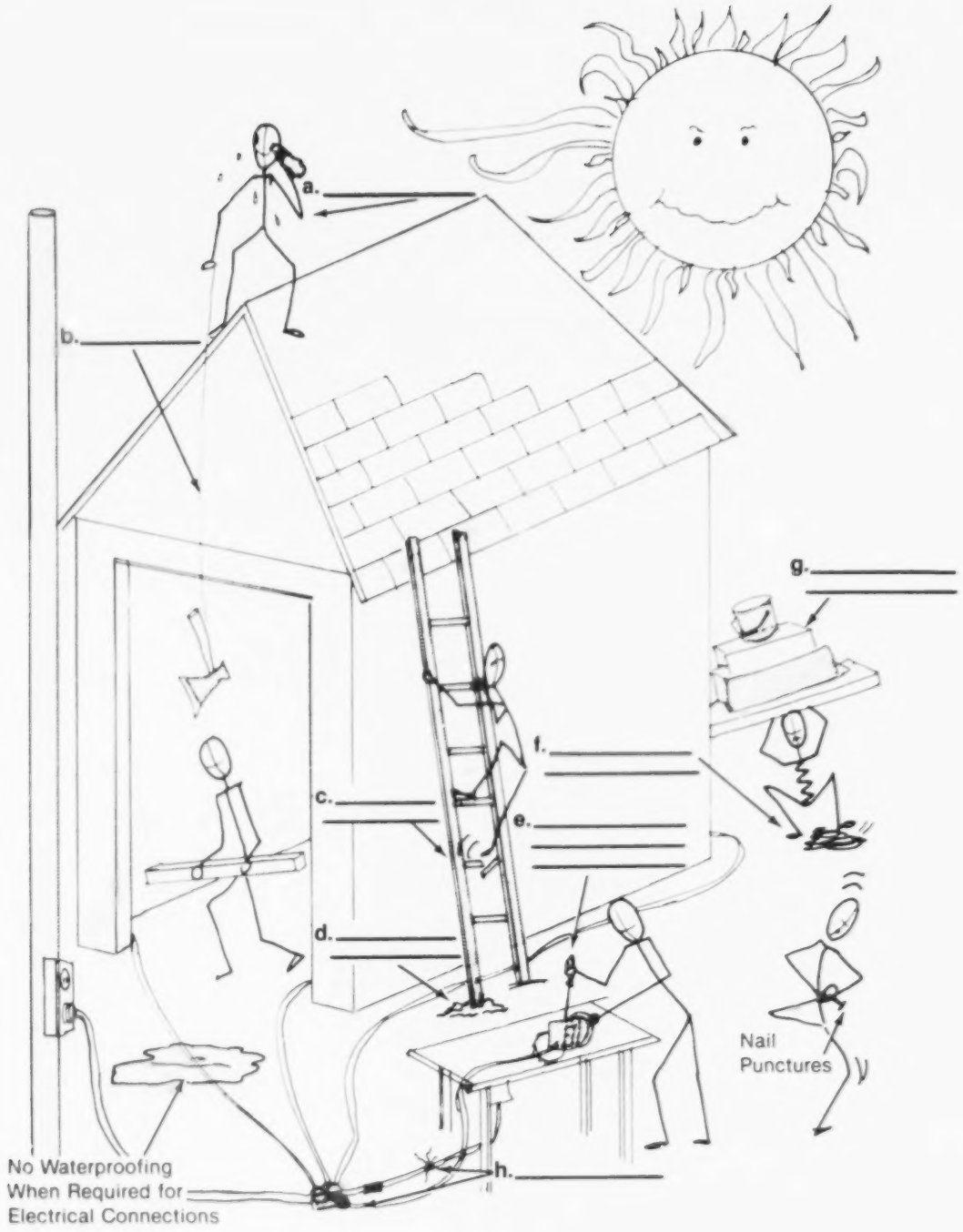
ASSIGNMENT SHEET #3 — IDENTIFY UNSAFE CONSTRUCTION PRACTICES

NAME _____ SCORE _____

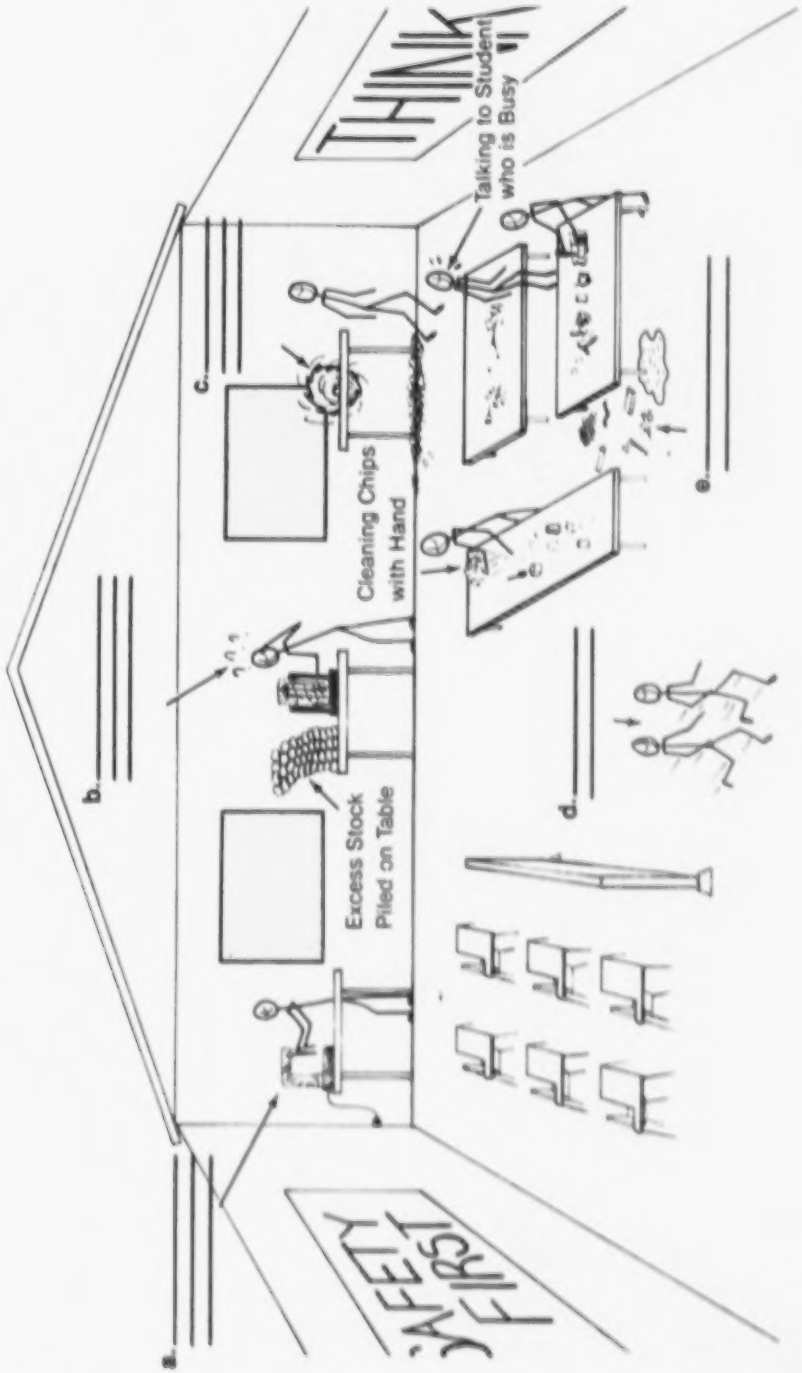
Directions: Describe accidents that are happening by filling in the blanks below and on the following pages.



ASSIGNMENT SHEET #3



ASSIGNMENT SHEET #3



CONSTRUCTION SAFETY
UNIT II

ASSIGNMENT SHEET #4 — COMPLETE A WORD SEARCH OF SAFETY TERMS

NAME _____ SCORE _____

Directions: Find the safety terms in the word search below and circle them. The terms may be horizontal, vertical, forward, backwards, or diagonal.

Safety terms: Accident, safety glasses, hard hats, face shield, safety rules, gloves, guard, fall, injury, permission, carelessness, horseplay, fire, pledge, skill, power tool, ladder, casualty

A	S	P	O	W	E	R	T	O	O	L	P	O
C	A	R	E	L	E	S	S	N	E	S	S	F
A	F	A	C	E	S	H	I	E	L	D	A	P
S	E	P	G	J	D	T	R	T	T	L	F	E
U	T	H	H	C	O	S	K	I	L	L	E	R
A	Y	O	G	A	C	C	I	D	E	N	T	M
L	G	R	U	K	R	O	Y	J	X	T	Y	I
T	L	S	A	U	P	D	K	F	K	I	R	S
Y	A	E	R	P	L	S	H	E	I	L	U	S
L	S	P	D	E	E	M	N	A	U	R	L	I
T	S	L	A	D	D	E	R	K	T	A	E	O
B	E	A	X	U	G	L	O	V	E	S	S	N
G	S	Y	Y	N	E	I	N	J	U	R	Y	O

CONSTRUCTION SAFETY
UNIT II

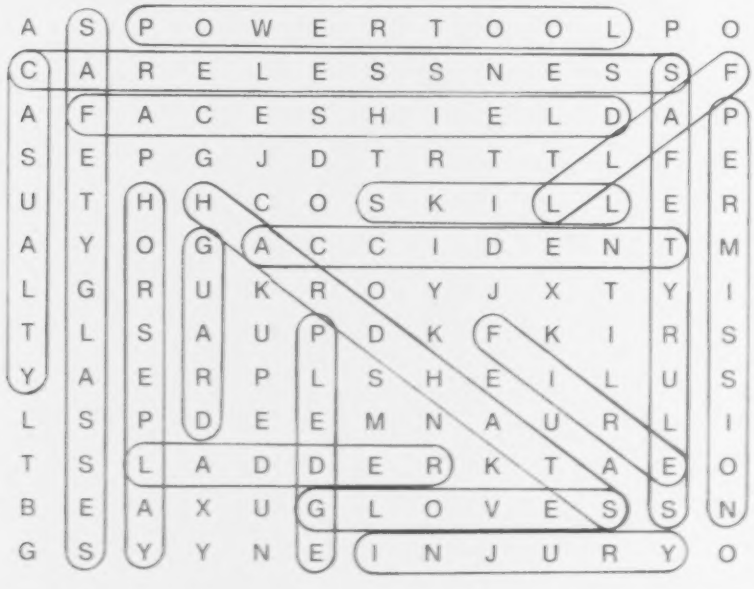
ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Each pledge should be kept in student's file along with other safety tests.

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

Assignment Sheet #3 — Refer to TMs 1-3 for answers

Assignment Sheet #4


A S P O W E R T O O L P O
C A R E L E S S N E S S F
A F A C E S H I E L D A P
S E P G J D T R T T L F E
U T H H C O S K I L L E R
A Y O G A C C I D E N T M
L G R U K R O Y J X T Y I
T L S A U P D K F K I R S
Y A E R P L S H E I L U S
L S P D E E M N A U R L I
T S L A D D E R K T A E O
B E A X U G L O V E S S N
G S Y Y N E I N J U R Y O

CONSTRUCTION SAFETY
UNIT II

NAME _____ SCORE _____

TEST

1. Discuss the following situations concerning laboratory and site safety.

   a. John was using a tool that was too dull. He had to use force, it slipped and he was hurt. What safety rule did he fail to follow?

   _____

   b. Marsha was running in the laboratory. She ran into the edge of the table and was hurt. What safety precaution did she forget?

   _____

   c. It is best to use a (**bare hand, a glove, a brush**) to clean a table surface or machine.

   d. It is fun to talk and interrupt someone when they are using machinery. Why is this not allowed in a safe lab?

   _____

2. Discuss two personal safety precautions involving dress and material handling.

   a. Dress

      1) _____

      2) _____

   b. Material handling

      1) _____

      2) _____

3. Complete the following statements concerning housekeeping practices.

   a. Keep aisles and walkways (**clear, full**) of tools, materials, and debris.

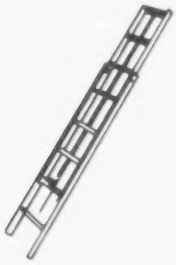
   b. Dispose of scraps and rubbish (**daily, weekly**) to prevent fires.

   c. Whenever you see protruding nails, what should you do about them? _____

   _____

TEST

4. Identify the basic types of ladders shown by writing the correct names in the blanks provided.



a. _____ b. _____ c. _____

5. Select true statements concerning correct ladder use by placing an "X" in the blanks preceding the true statements and an "O" in the blanks preceding the false statements.

_____a. A ladder is intended to hold up to three people.

_____b. Inspect ladders carefully before use.

_____c. Keep steps and rungs free of oil, grease, paint, or other slippery substances.

_____d. Ladders may be used anywhere.

_____e. Never stand on the top, pail rest, or rear rungs of a folding stepladder.

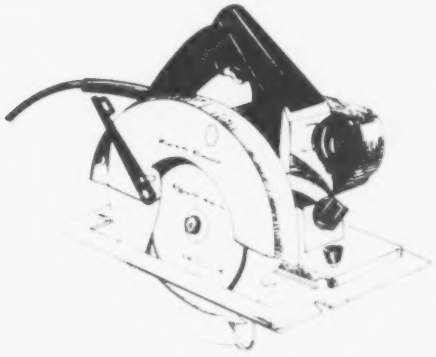
_____f. Stepladders may safely be used in half open position.

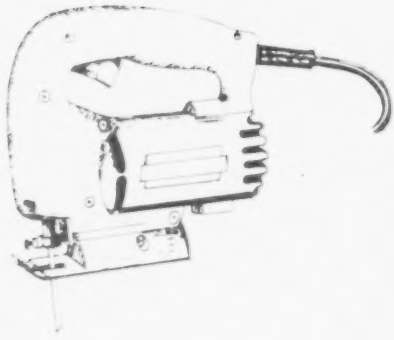
_____g. Reach as far as you can when you are on a short ladder.

_____h. Use ladders both in vertical and horizontal positions.

TEST

6. List two rules for correctly using the following power tools.



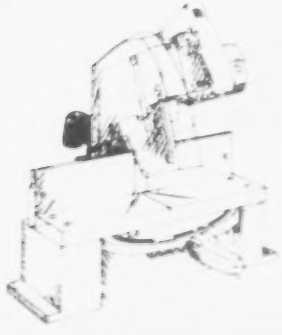


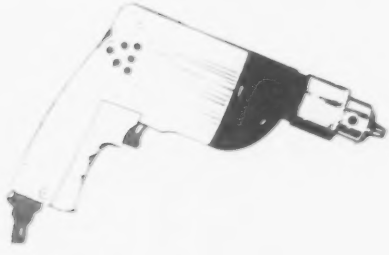
a. 1) _____

2) _____

b. 1) _____

2) _____





c. 1) _____

2) _____

d. 1) _____

2) _____

7. Complete the following statements concerning general safety for portable power tools by supplying the correct word or words.

a. Operate power tools only after _____ instruction and completing test over that tool.

b. Operate power tools only with instructor's _____.

c. Always wear approved eye _____.

d. Always _____ the power plug when work is complete.

e. Be sure the switch is in the _____ position before connecting the power plug.

f. _____ use portable power tools in contact with water.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Complete a safety pledge. (Assignment Sheet #1)

9. Survey laboratory facilities. (Assignment Sheet #2)

10. Identify unsafe construction practices. (Assignment Sheet #3)

11. Complete a word search of safety terms. (Assignment Sheet #4)

CONSTRUCTION SAFETY
UNIT II

ANSWERS TO TEST

1. a. Always use sharp tools.
   b. Always walk — do not run.
   c. Brush
   d. It may cause an accident.

2. Answers should include any two for each of the following:
   a. Dress
      1) Wear protective equipment as required — Safety glasses, gloves, shoes, hard hats, goggles, ear protection, face shields.
      2) Clothing should suit your individual needs.
      3) Clothing worn in the laboratory or on the job site should be acceptable for the activity.
      4) Avoid wearing pants or overalls that are too long. Cuffs made by turning up the legs of pants tend to catch heels, causing falls.
      5) To avoid catching on nails, keep the sleeves of shirts or jackets buttoned.
      6) Keep hair cut short or keep long hair secured safely.
      7) To protect feet from protruding nails, wear shoes with thick, sturdy soles.
      8) Wear a hard hat when exposed to overhead work or whenever there is danger from falling objects.
      9) Remove neckties, rings, wristwatches, neck chains, and other jewelry.
   b. Material handling
      1) Long pieces of material should be carried by two persons.
      2) Use the muscles in your legs and knees to lift heavy objects. Do not lift with your back muscles.
      3) Observe caution when carrying planks or other objects across frozen, wet, or otherwise slippery footing.

3. a. Clear
   b. Daily
   c. Remove them or bend them down immediately

4. a. Extension
   b. Straight
   c. Folding

5. a. O
   b. X
   c. X
   d. O
   e. X
   f. O
   g. O
   h. O

ANSWERS TO TEST

6. Any two rules for each of the following:
   a. Portable power saw
      1) Make sure blade is the proper type for the work to be done.
      2) Make sure blade is properly installed and the arbor nut is tight.
      3) Make certain that work to be cut is firmly supported, clamped, and free of obstruction.
      4) Check to see if the blade guard is functioning before connecting power source.
   b. Saber saw
      1) Make sure the blade is correct for the job to be performed and tightly clamped in chuck.
      2) Use clamps or vises to hold material to be cut.
      3) Always hold the saw base tightly against material to be cut.
   c. Motorized miter box
      1) Always hold the work firmly against the fence and table.
      2) Install a new table if adequate support has been cut away.
      3) Allow motor to reach full speed before starting to cut.
      4) Use the brake to stop the blade before removing scrap or chips from the work area.
      5) Do not attempt to cut oversized stock.
      6) Enlist a helper to support end of long stock.
      7) Turn off motor immediately after making cut.
   d. Portable electric drill
      1) Make certain drill bit is securely gripped in chuck.
      2) Check to see that key is removed from chuck before starting.
      3) Drill with steady, even pressure. Let the drill do the work.

7. a. Receiving
   b. Permission
   c. Protection
   d. Disconnect
   e. "Off"
   f. Never

8.—11. Evaluated to the satisfaction of the instructor

DESIGN AND PLANNING
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to apply the steps of the design and construction process to plan a construction project. Competencies will be demonstrated by completing the assignment sheet, job sheet, and the unit tests with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to design and planning with the correct definitions.
2. Arrange in order the steps in the design and engineering process.
3. List types of public construction projects.
4. Complete statements concerning building codes.
5. Select true statements concerning building standards and material specifications.
6. List types of soil tests.
7. Match types of legal landdescriptions with the correct descriptions.
8. Select true statements concerning working drawings.
9. Select from a list the facters involved in cost estimating.
10. Arrange in order the stepsin securing a building permit.
11. Identify types of bridges.
12. Select and purchase a construction site. (Assignment Sheet #1)

OBJECTIVE SHEET

13. Research a legal land description. (Assignment Sheet #2)

14. Demonstrate the ability to:

    a. Design and build a truss bridge. (Job Sheet #1)

    b. Stress test a truss bridge. (Job Sheet #2)

DESIGN AND PLANNING
UNIT III

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Provide students with job sheet.

H. Discuss and demonstrate the procedure outlined in the job sheet.

I. Integrate the following activities throughout the teaching of this unit:

1. Give a brief presentation on the design process.

2. Have students form design teams and use common ideas to produce sketches for projects.

3. Use a set of plans to discuss working drawings. Discuss what they are, how they are made, and why they are made. Give special attention to the floor plans.

4. Discuss labor and management problems.

5. Role play the problem of better working hours between management and construction workers.

6. Use a map of your state or county to discuss legal land descriptions. Discuss common methods of describing land in your state.

7. Discuss math principles involved in designing bridges. (Job Sheet #1)

8. Show blueprint symbols that students need to be familiar with to read the working drawings for their construction project.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

SUGGESTED ACTIVITIES

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

B. Lux, Donald G., et. al. *World of Construction.* Bloomington, IL: McKnight Publishing Co., 1982.

C. Hendrix, Laborn J. *Fundamentals of Carpentry.* Stillwater, OK. AGC and Oklahoma State Department of Vo-Tech Education, 1985.

D. Hendrix, Laborn J. *Residential Carpentry.* Stillwater, OK. AGC and Oklahoma State Department of Vo-Tech Education, 1985.

E. Spence, William P. *Architecture.* Peoria, IL: Bennett and McKnight Publishing Co., 1985.

F. Davis, Ronald and Bruce Yancey: *Architectural Drafting.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1982.

G. Hoag, John S. *Fundamentals of Land Measurement.* Chicago, IL: Chicago Title Insurance Co., 1971.

H. *Competitive Events Guidelines,* revised edition. Reston, VA. National AIASA, 1985.

I. Todd, R., D. McCrory, K. Todd. *Understanding and Using Technology.* Worcester, MA: Davis Publications, Inc., 1985.

SUGGESTED SUPPLEMENTAL MATERIALS

A. Filmstrips

(NOTE: Filmstrips 1 and 2 are available for a fee and may be ordered from the University of Wisconsin, Bureau of Audio-Visual Instruction, P.O. Box 2093, Madison, Wisconsin 53701-2093.)

1. *The Foundation*

2. *Wood Shell*

SUGGESTED SUPPLEMENTAL RESOURCES

3. *The Other Bridge* — Video ½", color, 27 minutes, 1984.

   Explores the construction, design, and operation of the San Francisco-Oakland Bay Bridge. Includes an in-depth look at the world of engineering and design. Available from:

   Centre Productions, Inc.
   1800 30th Street, #207
   Boulder, CO 80301
   1-800-824-1166

4. *Civil Engineering*, CS-104
   Civil engineers working in a variety of responsibilities in government, industry, and private consulting practice are introduced. They are shown at their jobs in design, quality control, project supervision, and top level administration in such areas as transportation, building construction, utilities, and environment. Educational background and professional associations relating to civil engineering are also noted.

5. *Community Planning*, CS-105
   This video program presents an in-depth look at the role and importance of a community planner in today's society. Planners come from a variety of backgrounds and are all engaged in solving the problems of densely populated areas, traffic, the need for parks and green belts, easy accessibility to schools and churches, and the protection of the environment.

   4-5 available in VHS and Beta from:

   Morris Video
   413 Avenue G #1
   P.O. Box 443
   Redondo Beach, CA 90277
   1-800-843-3606

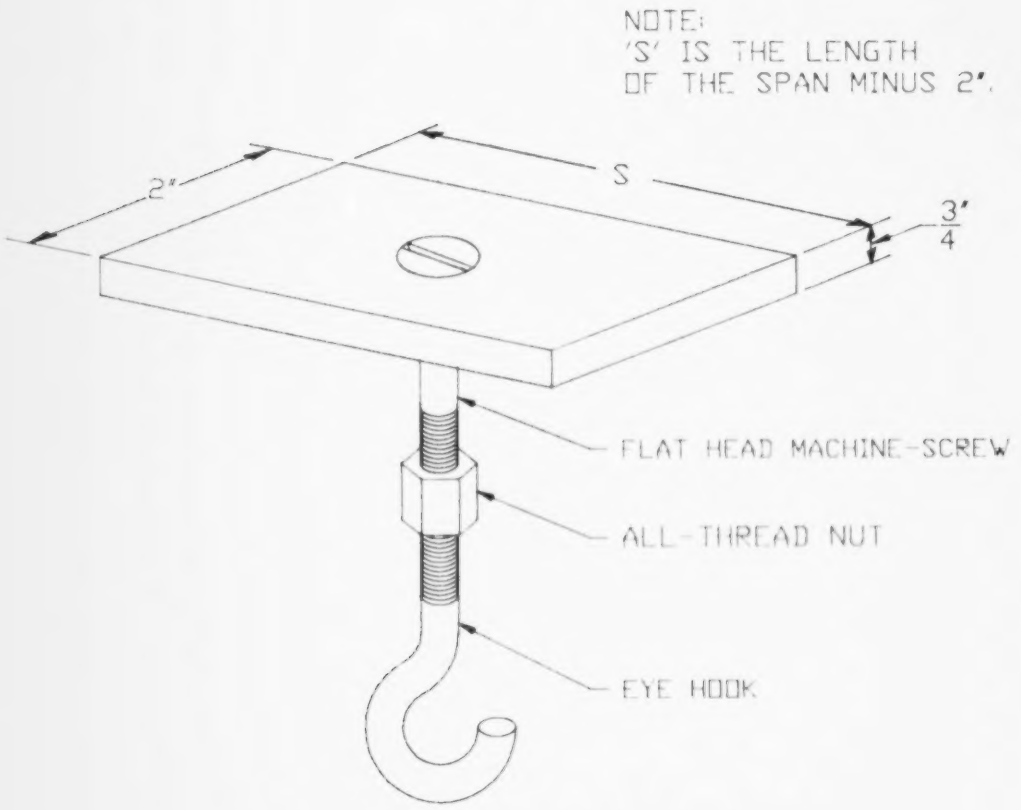
DESIGN AND PLANNING
UNIT III

TEACHER SUPPLEMENT #1 — TEST BLOCK SPECIFICATIONS

(NOTE: This test system is for concentrated stress testing.)

A. Bridge must accommodate test block on the roadbed and allow for the bolt to protrude through the bottom of the bridge. (S is the length of the span minus 2".)

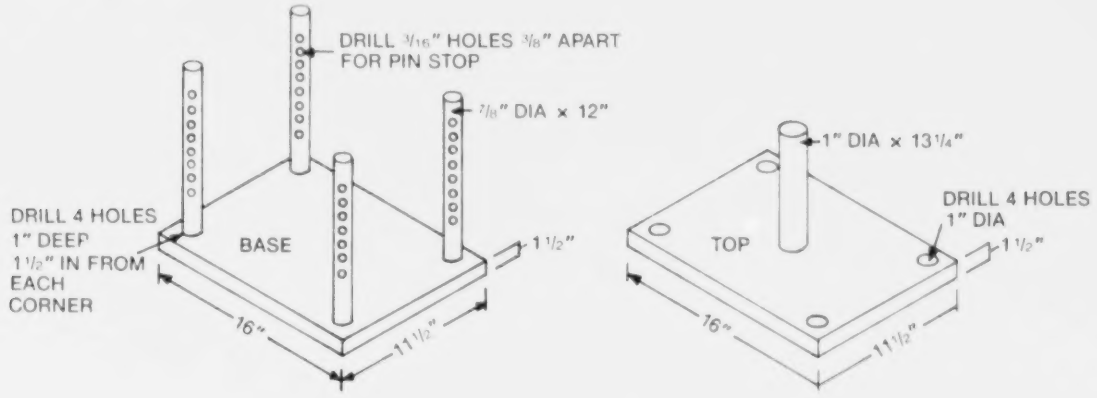
B. After the block is in place, the hook will be attached and a load can then be applied to the hook.



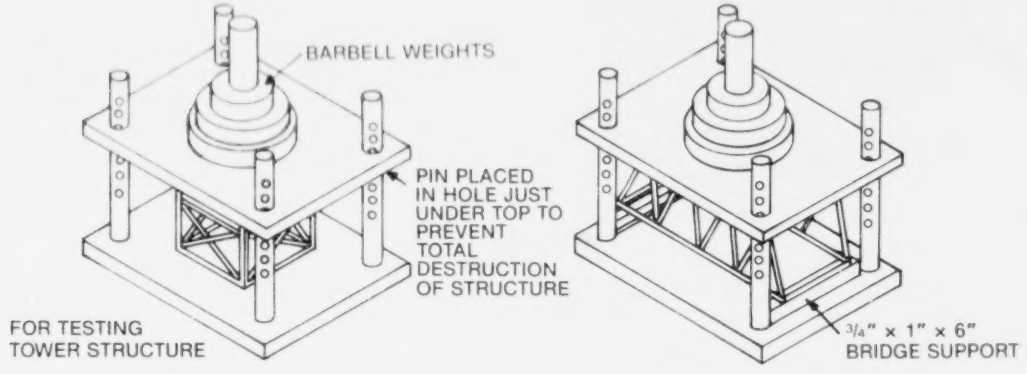
DESIGN AND PLANNING
UNIT III

TEACHER SUPPLEMENT #2 — ALTERNATE TRUSS BRIDGE STRESS TEST

(NOTE: This test system is for uniform load testing.)



Remember to add the weight at the top of the total load placed on the structure. Bridge supports should be located at the point that is given in the problem as the distance the bridge has to span.


BARBELL WEIGHTS
PIN PLACED IN HOLE JUST UNDER TOP TO PREVENT TOTAL DESTRUCTION OF STRUCTURE
FOR TESTING TOWER STRUCTURE
3/4" x 1" x 6" BRIDGE SUPPORT

Construction Idea: 2 x 12 could be used for the construction of the base and top of the "structure crusher." Two 3/4" pieces of plywood will also work if they are laminated together.

DESIGN AND PLANNING
UNIT III

INFORMATION SHEET

I. Terms and definitions

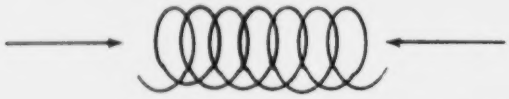
A. Base line — Line running both east and west that extends across lands to be surveyed

(NOTE: There are 32 base lines established in the U.S.)

B. Building codes — Principles and rules that govern the construction of a building; primarily are designed to protect the consumers' health and safety

C. Building permit — Written permission to build that is granted by a local government authority

D. Compression — The force of a load that causes the molecules of construction materials to shorten



E. Contractors — People who organize and direct construction by managing the work to be done and the people and materials to do it

F. Grade — The elevation above sea level of the ground on a building site

G. Legal land description — A written statement recognized by law as a definite location of a tract of land by reference to a survey, recorded map, or adjoining property

H. Monuments — Natural or artificial objects properly located and witnessed used as a reference point for surveying

Examples: Natural monuments — trees, rivers
Artificial monuments — highways, section corners, stones

I. Principal meridians — Lines running north and south from initial points and extending across the area to be surveyed

(NOTE: There are 35 principal meridians in the U.S.)

J. Restrictive covenants — Limitations on the use of a property

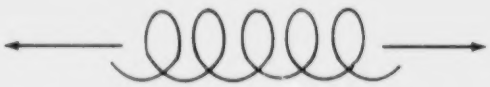
K. Soil testing — Examination and testing of samples of earth to collect data concerning the stability and land-bearing capabilities of the earth at a particular site

INFORMATION SHEET

L. Specifications — Written instructions giving construction details that are easier to describe with words than with drawings

M. Stress test — To apply pressure or weight to the point of collapse

N. Tension — The stress of a load that pulls apart the molecules of construction materials



O. Working drawing — A drawing or sketch giving dimensions and other information needed for construction

II. **Steps in the design and engineering process** (Transparency 1)

(NOTE: The work involved in these steps is often complex.)

A. Problem identification

1. Determine needs of society or client.

   Examples: Why is the project needed? What purpose is it to serve? What safety measures are needed?

2. Gather information about problem.

   Examples: Flood problems, lack of electricity, traffic problems

B. Preliminary ideas

1. Many ideas are considered and recorded.

2. Sketches are made.

3. Ideas are studied, restudied, and discussed with client.

C. Refinement

1. Several of the best ideas are improved.

2. Each idea is developed in more detail.

3. Architect or engineer determines lengths, sizes, shapes, and angles of design.

INFORMATION SHEET

D. Analysis — The best factors are looked at in each design idea. Four factors are studied.

1. Site — Special features of the land are considered if they may affect the design.
2. Structure — A model is made to help detect faults in the design.
3. Function — The design must show that the project will serve its intended purpose.
4. Costs — Construction cost is considered. One design solution may be more economical than the other.

E. Decision

1. The best engineered design is selected.
2. The designer makes a presentation to the clients.
3. The designer and client decide which design solution will be constructed.

F. Implementation

1. Detailed drawings and specifications are prepared.
2. The engineer works closely with the builder (contractor) during actual construction.
3. The structure is usually built as planned. Some changes may be made during the construction phase.

III. Types of public construction projects

(NOTE: As a community grows and changes, public services and facilities are needed and their development requires special construction considerations.)

A. Public transportation

Examples: Streets and roads, railroads, waterways, bridges, dams

B. Public buildings

Examples: Public schools, libraries, courthouses

C. Public utilities

Example: Gas, electricity, sewers, water

INFORMATION SHEET

IV. Building codes

A. Building codes are a collection of laws published in a booklet form. These laws are adapted and adjusted by local communities, cities, counties, and state governments to regulate and standardize building in that area.

B. Codes must be followed for new construction as well as alterations, repairs, and demolition of old construction.

(NOTE: Because technology continues to improve construction materials and techniques, building codes must be periodically reviewed and updated. There are four major organizations that provide this service — 1. The Uniform Building Code, 2. Basic Building Code [BOCA], 3. National Building Code, and 4. Standard Building Code.)

C. Codes are enforced by inspectors who make periodic checks during construction to make sure the codes are being followed. Inspectors check the electrical, plumbing, heating, ventilation, air conditioning, and construction work.

(NOTE: Most state codes deal mainly with safety and fire protection and special needs for public buildings.)

V. Building standards and material specifications

A. Building standards are developed by manufacturers, trade associations, government agencies, professionals, and tradespeople, all of whom are seeking a desirable level of quality through efficient means.

B. Organizations devoted to the establishment of standards relating to the field of construction are:

1. The American Society for Testing and Materials (ASTM)
2. American National Standards Institute (ANSI)
3. Underwriter's Laboratories, Inc. (UL)

C. Material specifications were established and used in order to avoid any misunderstanding between the contractor and the owner. Specifications cover such things as:

1. General conditions of the contract
2. Special conditions of the contract, and
3. General and specific scope of work

INFORMATION SHEET

VI. Types of soil tests

(NOTE: All structures must have strong foundations. A foundation remains strong and firm only if the earth supports it. Before designing can begin, it is important to know the nature of the soil. Soil testing gives this information.)

A. Laboratory soil tests

1. Soil strength (shear test)
2. Water in the soil (liquid-limit test)
3. Soil plasticity (plastic-limit test)
4. Soil compressibility (compression test)

B. Field soil tests

1. Soil stability (plate-bearing test)
2. Settlement (plate-bearing test)
3. Compaction (density test)
4. Depth of bedrock (geophysical test)

VII. Types of legal land descriptions (Transparency 2)

(NOTE: Every piece of land in the U.S. has been surveyed and its legal description is on file with the county. This description is used in all legal matters such as land transfers.)

A. Metes and bounds descriptions — Oldest method of describing land in the U.S. Used in the 13 original colonies. Also currently used to describe irregular plats

B. Lot and block descriptions — Primarily used to describe plats and subdivisions of land

C. State plane coordinate descriptions — Newest method of describing land using X and Y coordinates

D. Sectional descriptions using U.S. public land survey system — Method based on principal meridians and base lines which divide large areas of land into quadrangles, townships, sections, 1/2 sections, 1/4 sections, and 1/4-1/4 sections.

(NOTE: The quarter-quarter section of 40 acres is the smallest statutory division of regular sections. Lot and block descriptions are used to further divide 1/4-1/4 sections.)

Example of a sectional description: SW 1/4 of NE 1/4 of Section 6, Township 39 N, Range 13 E of the Third Principal Meridian in Cook County, Illinois

INFORMATION SHEET

VIII. Working drawings (Transparency 3)

A. Are prepared after the analyzed design is approved.

B. Are made by a drafter for the architect.

C. Are intended to be used by the builder.

D. Show how the structure is to be placed on a site.

E. Are fully detailed and dimensioned.

F. A set of working drawings normally consists of

1. Plot plan
2. Footing and foundation plans
3. Floor plans
4. Exterior elevations
5. Mechanical plans (plumbing and HVAC)
6. Electrical plan
7. Structural details
8. Finish schedules

(NOTE: There are other details that may be included depending on the complexity of the project.)

IX. Factors involved in cost estimating

(NOTE: When contractors bid a contract, they must have estimates of what the work will cost. The success and profit of a contractor depends much upon the ability of the estimator.)

A. Materials cost — Estimators study the plans and specifications and count how many times a certain item appears on the plan. They then multiply that number by the cost of a single item.

Example: An estimator may count 200 windows on a plan. To determine the cost, the estimator may:
1. Consult a catalog for the price
2. Call the company's purchasing department
3. Call a company that sells windows

Suppose the estimator found the best price for the windows were $250 each, including delivery.
Windows × Unit cost = Total cost of windows
200 × $250 = $50,000

INFORMATION SHEET

B. Labor cost — The estimator must determine how much it will cost to pay the workers.

Example: 100 doors need to be installed in a building. It takes a carpenter one hour to hang a door plus two hours of laborer time is required. This is called labor productivity.

(NOTE: The estimator must know hourly wage for each person.)

Assume carpenters earn $10 an hour.
hour × doors × labor cost = carpenter cost
1 × 100 × $10 = $1000
Assume laborers earn $6 per hour.
hour × doors × labor cost = laborer cost
2 × 100 × $6 = $1200
Installing the doors would cost $2200.

(NOTE: This does not include the cost of doors themselves or other benefit costs for workers such as social security, worker's compensation, unemployment, or insurance. When all costs are added together, it would give the total labor estimate.)

C. Equipment cost

1. Rented equipment is leased by the hour plus fuel and repair cost.

2. Contractor-owned equipment may charge an hourly rate. To calculate this rate, operating cost, insurance, depreciation, etc. must be included.

D. Overhead cost (an indirect cost) — This cost may include:

1. Home-office cost — Rent and utilities, travel, executive salary, etc.

2. Job-overhead cost — Surveying, soil test, superintendent's and supervisor's salaries, building permits, storage, etc.

E. Profit cost (markup) — Usually expressed in a percentage and is determined by the top management of the contracting firm.

(NOTE: A contractor often obtains the services of a subcontractor. The cost of the subcontract work must be included in construction cost estimating.)

X. **Securing a building permit** (Transparency 4)

(NOTE: Securing building permits will vary from area to area but the following will be basic to most communities or cities.)

A. The contractor or building owner files an application with the city clerk. The application and one or two sets of the plans are required. Working drawings and specifications must be submitted as well as necessary engineering reports and studies.

INFORMATION SHEET

B. Plans are reviewed by building officials to determine if they are satisfactory.

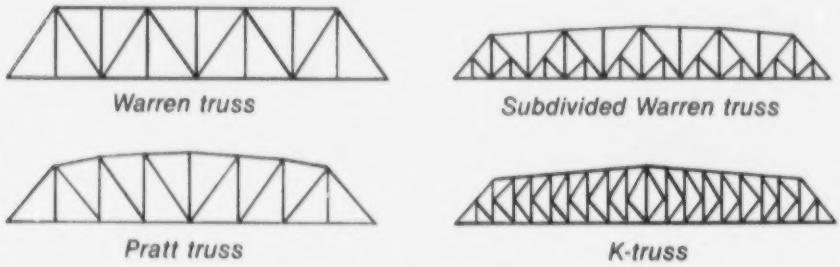
C. Permits are issued if plans are approved.

D. Permits and an inspection card are posted on the building site. (Transparency 4)

(NOTE: Work on the structure should not proceed beyond the point indicated in each inspection visit. For example, mechanical work and electrical work should not be enclosed before being inspected. A final inspection and occupancy permit must be issued in some areas before the building can be occupied.)

XI. Types of bridges

A. Truss bridges — Trusses are often used instead of beams to support the roadway. A truss is a rigid framework, made by connecting long, straight pieces of wood, steel, or aluminum. These connected pieces form triangles. Several trusses are shown below.



Warren truss

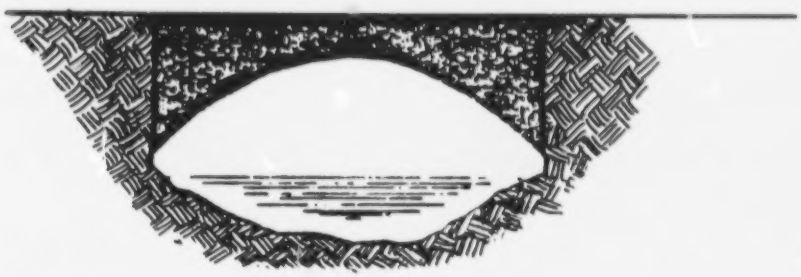
Subdivided Warren truss

Pratt truss

K-truss

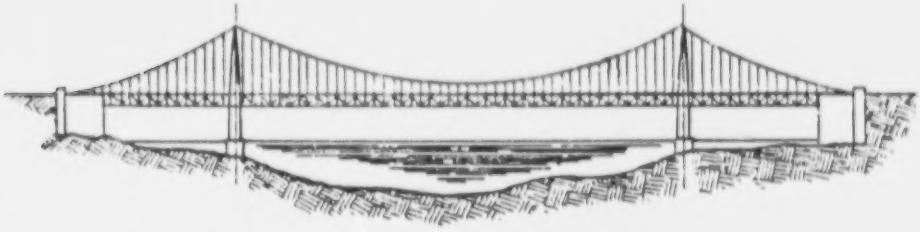
(NOTE: Trusses must be carefully designed to span great distances and withstand tension and compression stresses.)

B. Arch bridge — Modern arch bridges are made of steel and reinforced concrete and are used to span deep ravines.



INFORMATION SHEET

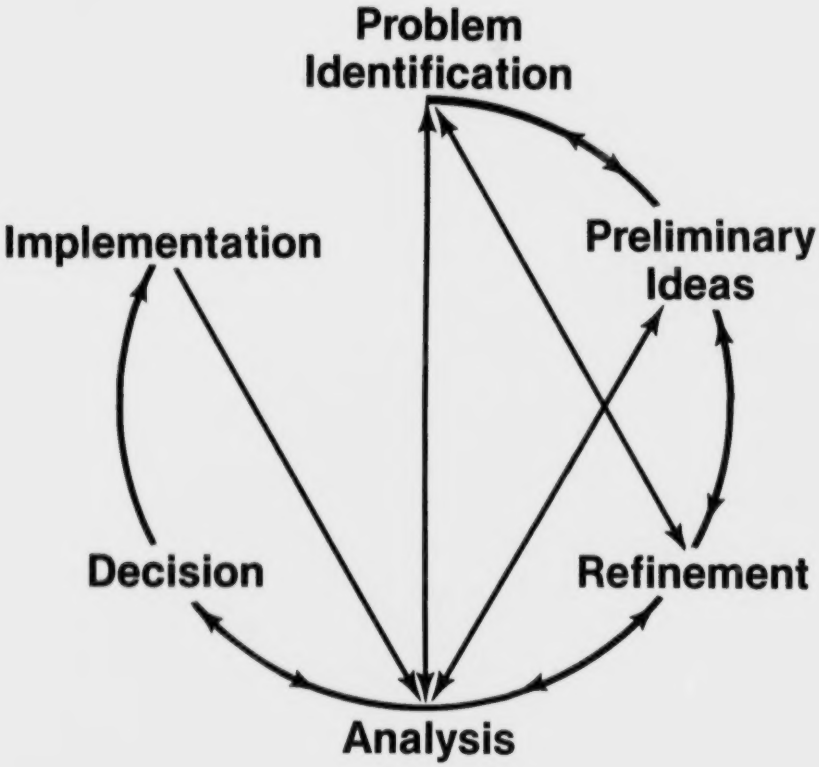
C. Suspension bridge — Used over very long crossings. These bridges are made of thousands of parallel, galvanized-steel wires. The cables pass over a tower.



D. Slab bridge — The simplest type of bridge. Is made of reinforced concrete slabs for short spans. On longer spans beams are used to support the slab.

(NOTE: A bridge designer will decide on what type of bridge to build, what building materials to use, and the size of the bridge required based on the location, purpose, and required strength of the finished bridge.)

The Design and Engineering Process



Solving a design and engineering problem is not simple. Ideas must continually be questioned. Often, ideas do not meet the requirements, but those ideas may lead to other ideas that will work. This process is considered a cycle.

Legal Land Descriptions

All that part of the Northeast Quarter of the Northeast Quarter of Section 12, Township 5 North, Range 2 East of the Fifth Principal Meridian, Clarion Township, Walker County, and State of Missouri, described as follows:

← Public Land Sectional Description

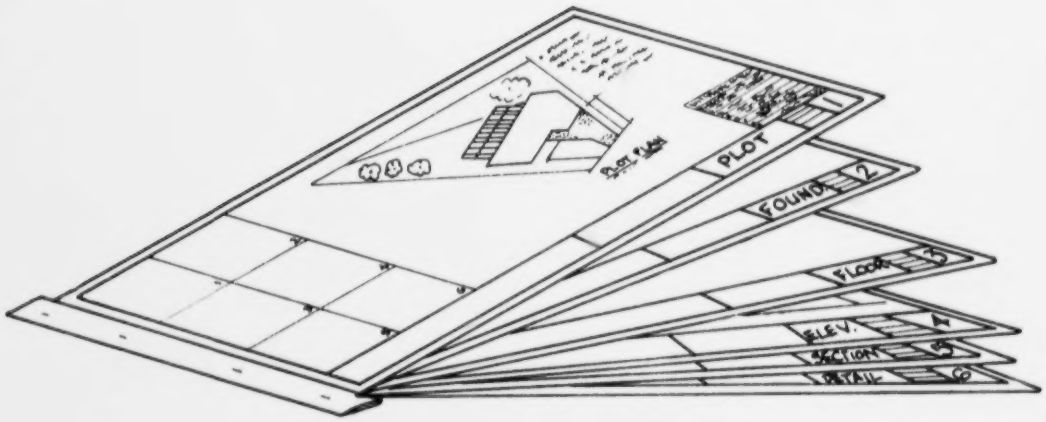
Commencing at the Northeast Corner of said Section 12;
Thence on an assumed bearing of South 89°58′40″ West on and along the north line of Section 12 a distance of 825.00 feet to the point of beginning;
Thence South 0°02′20″ West a distance of 721.78 feet;
Thence South 89°58′40″ West a distance of 320.22 feet;
Thence North 31°18′20″ West a distance of 844.57 feet to the said north line of Section 12;
Thence North 89°58′40″ East a distance of 759.55 feet on and along the said north line of Section 12 to the point of beginning.

← Metes and Bounds Description

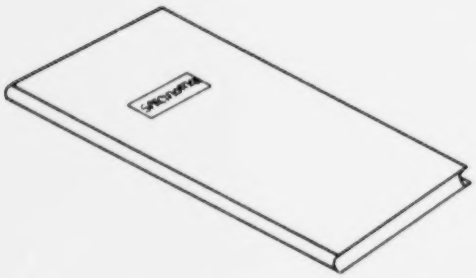
ALSO known as Lot 5, Block 4, Oak Hills Subdivision, Walker County, Missouri.

← Lot and Block Description

Working Drawings



Set of Working Drawings



Specifications

Building Permit

Bldg. Permit No. _____ Elec. Permit No. _____

Plbg. Permit No. _____ Date Issued _____

Street Address _____ Lot _____ Block _____

General Contractor's Name _____ Phone _____

Address _____

	REJECTED	ACCEPTED
BUILDING		
1st Inspection: Foundations		
2nd Inspection: Drywall		
3rd Inspection: For Occupancy Permit		
For Building Inspections Call _ _ _ - _ _ _ _		
PLUMBING		
Plumbing Contractor:		
1st Inspection: Exterior Rough-In		
2nd Inspection: Drywall		
3rd Inspection: Final		
For Plumbing Inspections Call _ _ _ - _ _ _ _		
ELECTRICAL		
Electrical Contractor		
1st Inspection: Drywall		
2nd Inspection for Occupancy Permit		
For Electrical Inspections Call _ _ _ - _ _ _ _		
PUBLIC WORKS INSP. CALL _ _ _ - _ _ _ _		
SEWER TAP—SEWER LINES & DRAIN LINES INSP. CALL _ _ _ - _ _ _ _		
WATER TAP—CALL _ _ _ - _ _ _ _		
HEATING—For Inspections Call _ _ _ - _ _ _ _		
REFRIGERATION (Permit Required) For Inspections Call _ _ _ - _ _ _ _		

NOTICE!

(1) The approval of the drawings will not sanction nor permit any violation of village zoning or building code.
(2) A complete set of approved drawings along with permit must be kept on the premises during construction.
(3) The permit will become null and void in the event of any deviation from the accepted drawings.
(4) No foundation, structural, electrical, nor plumbing work shall be concealed without approval.
(5) The building may not be occupied or used for storage without first obtaining an occupany permit.

No work shall be done on any part of the building beyond the point indicated in each successive inspection without acceptance. No structural framework of any part of any building or any underground work shall be covered or concealed without acceptance.

THIS PERMIT MUST BE PROMINENTLY DISPLAYED ON BUILDING AT ALL TIMES

DESIGN AND PLANNING
UNIT III

ASSIGNMENT SHEET #1 — SELECT AND PURCHASE A CONSTRUCTION SITE

NAME _____ SCORE _____

PART I

Directions: Work as a class, small group, or individually as directed by your instructor and choose three possible sites for a "dream" house construction site. Use the rating sheet to select one site. Consider the following factors in your selection: lot size, public utilities available, price, and topography (the natural features of the land).

1. Write the site addresses or brief descriptions in the space labeled: LOCATIONS.
2. Answer each question by rating each site from 1 for unacceptable to 5 for ideal.
3. When you have completed the ratings, add up the numbers for each site.
4. Select the site. The site with the highest number is the preferred site.

ASSIGNMENT SHEET #1

SITE RATING SHEET

Directions: Circle the appropriate ratings for each site.

SITE #	1	2	3
LOCATION			
1. Surroundings	12345	12345	12345
2. Topography	12345	12345	12345
3. Size of area	12345	12345	12345
4. Utilities	12345	12345	12345
5. Zoning	12345	12345	12345
6. Distance from neighbors	12345	12345	12345
7. Convenient transportation	12345	12345	12345
8. Distance to travel	12345	12345	12345
9. (Other)	12345	12345	12345
10. (Other)	12345	12345	12345
TOTAL RATINGS			
Indicate selection			
Explanation:_____			

ASSIGNMENT SHEET #1

PART II

Directions: Plan to purchase the land you selected in Part I. With your instructor's help, fill out the purchase agreement forms.

PURCHASE AGREEMENT

City _____ State _____ Date _____

Seller _____

Purchaser _____

The Purchaser agrees to purchase from the Seller the real estate known as _____

_____

_____

in the city/town of _____, _____ Township, _____ County, state of _____.

PURCHASE PRICE — Purchaser agrees to pay _____ dollars ($_____) upon the following terms.

METHOD OF PAYMENT

1. Cash and New Mortgage — The purchase price shall be $_____ paid in cash at the time of closing. The completion of the transaction shall depend on the purchaser obtaining conventional financing for _____ dollars ($_____), payable in not less than _____ monthly payments with interest at a rate not to exceed _____% per year. The purchaser has _____ working days to obtain financing.
2. Assumption of Existing Mortgage — Purchaser shall pay approximately _____ dollars ($_____) in cash at time of closing. The transaction will be complete upon delivery of a general warranty deed, and the purchaser assumes and agrees to pay the unpaid balance of existing mortgage held by _____ of approximately _____ dollars ($_____) as of _____ payable _____ dollars ($_____) per month at a rate of _____%.
3. Cash — The entire purchase price of _____ dollars ($_____) shall be paid in cash at the time of closing the transaction.

IMPROVEMENTS AND FIXTURES

The sales price includes all improvements permanently installed and affixed such as electrical and/or gas fixtures, all attachments such as built-in kitchen equipment and curtain rods, all landscaping, and the following: _____

_____

ASSIGNMENT SHEET #1

INSPECTION

Any inspections required by this Purchase Agreement shall be made within _____ working days.

CLOSING DATE

This transaction shall be closed on or before _____ working days after approval of financing.

POSSESSION

Seller may retain possession of property up to midnight _____, 19_____.

EARNEST MONEY DEPOSIT

As earnest money, the purchaser pays _____ dollars ($_____) which shall be applied to the purchase price at the time of closing the transaction or returned if the above terms and conditions of this contract are not met.

EXPIRATION AND APPROVAL

This Purchase Agreement is void if not accepted in writing on or before _____ o'clock (AM) (PM) of the _____ day of _____, 19_____.

Signature _____ (Purchaser)

Printed _____

Signature _____ (Purchaser)

Printed _____

ACCEPTANCE BY SELLER

The above Purchase Agreement is hereby accepted at _____ o'clock (AM) (PM) this _____ day of _____, 19_____. The undersigned agrees to sell the above real estate on the terms and conditions specified above.

Signature _____ (Seller)

Printed _____

Signature _____ (Seller)

Printed _____

DESIGN AND PLANNING
UNIT III

ASSIGNMENT SHEET #2 — RESEARCH A LEGAL LAND DESCRIPTION

NAME _____ SCORE _____

Directions: Work as a group or individually as directed by your instructor and find the legal land description for a piece of property identified by your instructor.

Examples: A proposed construction site
Your home
A park
Your school

(NOTE: Your parents or a school official may have an abstract or map showing the location of your home or school.)

Use legal terminology and write the description below.

DESIGN AND PLANNING
UNIT III

JOB SHEET #1 — DESIGN AND BUILD A TRUSS BRIDGE

A. Tools and materials

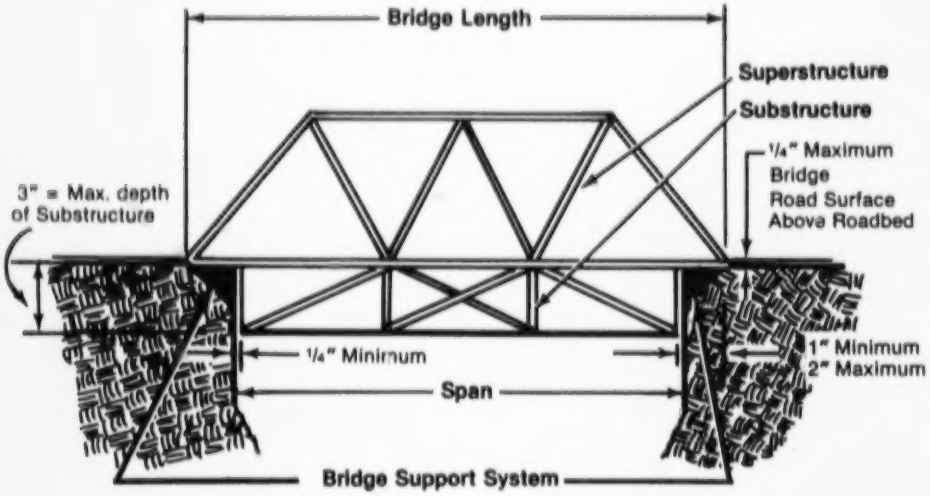
1. Balsa wood 1/8" × 1/8" strips
2. White glue
3. Cutting surface
4. Utility knife and blade
5. Straight pins
6. Ruler, 12"

B. Procedure

1. Follow instructor's directions for setting up work area.
2. Use a piece of plain paper and design a truss bridge with a span of 14" and a width of 4".

   (NOTE: Refer to Information Sheet, Section XI for truss designs. Others may be designed by you.)

   FIGURE 1



JOB SHEET #1

3. Construct bridge by joining the wood pieces together with the white glue.

   (NOTE: Do not use lamination on the construction process. Lamination is where two or more pieces of wood are glued together surface to surface without interruption.)

4. Use straight pins to hold glue joints together until dry.

5. Store bridge in drying area.

6. Clean up area.

DESIGN AND PLANNING
UNIT III

JOB SHEET #2 — STRESS TEST A TRUSS BRIDGE

A. Tools and materials

1. Completed truss bridge from Job Sheet #1 (allow 18 hours or overnight drying time)
2. Testing equipment (provided by instructor)
   a. Testing block
   b. Testing hook
   c. 2 five (5) gallon pails
   d. Lead shot weight or sand
   e. Large plastic cup or can
   f. Scales
   g. Calculator
   h. 2 tables or other device for bridge support system when testing

B. Procedure

(NOTE: To qualify for testing, the bridge must have a span of 14" and a width of 4" as stated in Job Sheet #1.)

1. Measure and record amount of wood used in the construction of the bridge.
2. Measure and record width and span.
3. Attach testing block and hook.
4. Place bridge between support system.
5. Suspend empty 5 gallon bucket on hook.
6. Place lead shot weight or sand in second 5 gallon bucket.
7. Begin pouring lead shot or sand by cupfuls into suspended bucket until the weight breaks the bridge.

JOB SHEET #2

8. Weigh sand and bucket.

9. Calculate efficiency using the following equalizing formula:

$$\text{Efficiency} = \frac{\text{Failure Weight}}{\text{Length of wood used}}$$

10. Clean up test area.

DESIGN AND PLANNING
UNIT III

PRACTICAL TEST
JOB SHEET #1 — DESIGN AND BUILD A TRUSS BRIDGE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools.	_____	_____
2. Followed instructor's direction.	_____	_____
3. Followed design well.	_____	_____
4. Used cutting tool safely.	_____	_____
5. Worked well as a team member.	_____	_____
6. Checked in or put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Performed steps in a timely manner (___hrs. ___min. ___sec.)	_____	_____
10. Practiced safety rules throughout procedure.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
	4	3	2	1
Met specifications				
	4	3	2	1
Neatness				
	4	3	2	1
Accuracy of plans and specifications				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

DESIGN AND PLANNING
UNIT III

PRACTICAL TEST
JOB SHEET #2 — TEST A MODEL TRUSS BRIDGE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Measured and recorded amount of wood.	_____	_____
2. Measured and recorded width and span of bridge.	_____	_____
3. Tested bridge as instructed.	_____	_____
4. Worked well as a team member.	_____	_____
5. Checked in/put away tools and materials.	_____	_____
6. Cleaned the work area.	_____	_____
7. Used proper tools correctly.	_____	_____
8. Performed steps in a timely manner (___hrs. ___min. ___sec.)	_____	_____
9. Practiced safety rules throughout procedure.	_____	_____
10. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Neatness				
	4	3	2	1
Met Specifications for Qualification				
	4	3	2	1
Strength				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

DESIGN AND PLANNING
UNIT III

NAME _____ SCORE _____

TEST

1. Match the terms on the right with the correct descriptions.

_____a.	Lines running north and south from initial points and extending across the area to be surveyed	1. Base lines
_____b.	Natural or artificial objects properly located and witnessed used as a reference point for surveying	2. Building codes
_____c.	A written statement recognized by law as a definite location of a tract of land by reference to a survey, recorded map, or adjoining property	3. Building permit
_____d.	Written permission to build that is granted by a local government authority	4. Compression
_____e.	A drawing or sketch giving dimensions and other information needed for construction	5. Contractors
_____f.	The elevation above sea level of the ground on a building site	6. Grade
_____g.	The stress of a load that pulls apart the molecules of construction materials	7. Legal land descriptions
_____h.	Principles and rules that govern the construction of a building; primarily are designed to protect the consumers' health and safety	8. Monuments
_____i.	Limitations on the use of a property	9. Principal meridians
_____j.	People who organize and direct construction by managing the work to be done and the people and materials to do it	10. Restrictive covenants
_____k.	To apply pressure or weight to the point of collapse	11. Soil testing
		12. Specifications
		13. Stress test
		14. Tension
		15. Working drawing

TEST

2. Arrange in order the six steps in the design and engineering process by placing the correct sequence numbers (1-6) in the appropriate blanks.

   _____a. Refinement

   _____b. Preliminary ideas

   _____c. Analysis

   _____d. Implementation

   _____e. Problem identification

   _____f. Decision

3. List two general types of public construction projects.

   a. _____

   b. _____

4. Complete the following statements concerning building codes by circling the correct words.

   a. Building codes are a collection of (**recommendations, laws**) published in a booklet form.

   b. Codes must be followed for (**new construction only, new construction and remodeling, remodeling only**).

   c. Codes are enforced by (**foremen, inspectors**) who make periodic checks during construction to make sure the codes are being followed.

5. Select true statements concerning building standards and materials specifications by placing an "X" next to the true statements.

   _____a. Building standards are developed by manufacturers, trade associations, government agencies, professionals, and tradespeople who are seeking a desirable level of quality through efficient means.

   _____b. An organization that helps to establish standards relating to the field of construction is the American National Standards Institute (ANSI).

   _____c. Materials specifications were established to make construction more difficult for contractors.

6. List the two general types of soil tests.

   a. _____

   b. _____

TEST

7. Match the types of legal land descriptions on the right with the correct descriptions.

_____a.	Method based on principal meridians and base lines which divide large areas of land into quadrangles, townships, sections, 1/2 sections, 1/4 sections, and 1/4-1/4 sections	1. Lot and block descriptions
_____b.	Primarily used to describe plats and subdivisions of land	2. Metes and bounds descriptions
_____c.	Newest method of describing land using X and Y numbers	3. Sectional descriptions
_____d.	Oldest method of describing land in the U.S. Used in the 13 original colonies. Also currently used to describe irregular plats	4. State plane coordinate descriptions

8. Select true statements concerning working drawings by placing an "X" next to the true statements.

_____a. Working drawings are prepared before the analyzed design is approved.

_____b. Working drawings are drawn by certified engineers only.

_____c. Working drawings are made to be used by builders.

_____d. Working drawings show how the structure is to be placed on a site.

_____e. Floor plans, foundation plans, and exterior elevations are normally included in a set of working drawings.

9. Select from the following list the factors involved in cost estimating by placing an "X" next to the correct factors.

_____a. Labor cost

_____b. Land cost

_____c. Materials cost

_____d. Equipment cost

_____e. Overhead cost

TEST

10. Arrange in order the four steps in securing a building permit by placing the correct sequence numbers (1-4) in the appropriate blanks.

    _____a. Plans are reviewed by building officials to determine if they are satisfactory.

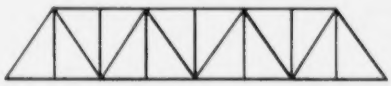
    _____b. Permits are issued if plans are approved.

    _____c. Permits and an inspection card are posted on the building site.

    _____d. The contractor or building owner files an application with the city clerk.

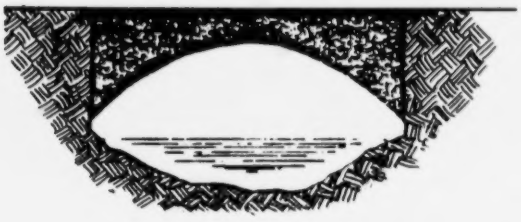
11. Identify the following types of bridges.

a. _____



b. _____

c. _____



d. _____

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

12. Select and purchase a construction site. (Assignment Sheet #1)

13. Research a legal land description. (Assignment Sheet #2)

14. Demonstrate the ability to:

    a. Design and build a truss bridge. (Job Sheet #1)

    b. Stress test a truss bridge. (Job Sheet #2)

DESIGN AND PLANNING
UNIT III

ANSWERS TO TEST

1. a. 9
   b. 8
   c. 7
   d. 3
   e. 15
   f. 6
   g. 14
   h. 2
   i. 10
   j. 5
   k. 13

2. a. 3
   b. 2
   c. 4
   d. 6
   e. 1
   f. 5

3. Any two of the following:
   a. Public transportation
   b. Public buildings
   c. Public utilities

4. a. Laws
   b. New construction and remodeling
   c. Inspectors

5. a, b

6. a. Laboratory soil tests
   b. Field soil tests

7. a. 3
   b. 1
   c. 4
   d. 2

8. c, d, e

9. a, c, d, e

10. a. 2
    b. 3
    c. 4
    d. 1

11. a. Slab
    b. Truss
    c. Suspension
    d. Arch

12.-14. Evaluated to the satisfaction of the instructor

CONSTRUCTION PREPARATION
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to organize and prepare a site for construction. Competencies will be demonstrated by completing the assignment sheets, job sheets, and the unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to construction preparation with the correct definitions.
2. Distinguish between the types of surveying for construction projects.
3. Match basic surveying equipment with the correct uses.
4. Identify the major parts of a level.
5. Distinguish between the types of contractors.
6. Select from a list the general types of contracts.
7. Arrange in order the steps in securing a contract.
8. Arrange in order the steps in scheduling construction.
9. Select from a list the correct procedures required when preparing to build.
10. Match site clearing methods with the correct descriptions.
11. Identify earthmoving equipment.
12. Distinguish between the types of excavating.

OBJECTIVE SHEET

13. Plan to clear a site. (Assignment Sheet #1)

14. Estimate a site clearing project. (Assignment Sheet #2)

15. Demonstrate the ability to:

    a. Set up and adjust a level. (Job Sheet #1)

    b. Locate a structure. (Job Sheet #2)

CONSTRUCTION PREPARATION
UNIT IV

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite rescurce people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Have the students bring construction job advertisements from their local newspaper. Give the situation of hiring workers for these jobs or the jobs determined by the class project. Have the students role play as personnel managers interviewing job applicants.

2. Hire or assign class members for jobs to be done during the construction project.

3. Post a chart of the construction project jobs and students' names hired for those jobs.

4. Show organizational charts for larger construction firms in your area.

5. Demonstrate the use of surveying equipment or ask a local surveyor to demonstrate to the class. Also discuss the cost of this equipment and the need for proper care and handling.

6. Show filmstrips which discuss surveying.

7. Review a set of plans with the class and discuss the survey information on the plans.

8. Use computer and software designed for construction scheduling.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

SUGGESTED ACTIVITIES

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

B. Lux, Donald G., et. al. *World of Construction.* Bloomington, IL: McKnight Publishing Co., 1982.

C. Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry.* Stillwater, OK. AGC and Oklahoma State Department of Vocational and Technical Education, 1985.

D. Olson, David A. *Basic Surveying Technology.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1987.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Filmstrips

(NOTE: The following color filmstrips come with a manual and may be ordered from the California State Polytechnic University, San Luis Obispo, California 93407.)

1. *Setting Up the Instrument*

2. *Reading the Rod*

B. Computer Software

Construction Estimator — Programs to be used with Apple and IBM

Available from: Mesa Research, Inc.
Route 12, Box 480
Waco, TX 76710
(817) 848-5272

C. *Land Survey,* CS-157

The diversity of surveying, mapmaking, and photogrammetry within different industries such as mining, oil exploration, and land subdivision are explored. The effects of new technology and techniques are explained in conjunction with varied training requirements and amenities.

Available from: Morris Video
413 Avenue G #1
P.O. Box 443
Redondo Beach, CA 90277
1-800-843-3606

CONSTRUCTION PREPARATION
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Bench mark (BM) — Permanent point of known or assumed elevation

B. Builder's level — Leveling instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

C. Contractors — Persons who manage construction by identifying work to be done and the people and materials to do it

D. Cross hairs — Fine horizontal and vertical lines in telescope of leveling instrument; used as reference lines in the field or for marking instrumental axis

E. Elevation — A given grade

F. Grade — Surface as referred to in construction

G. Grade stake — Stake driven into ground at proposed grade

H. Scheduling — A detailed plan of construction that gives the tasks and the order in which they are to be performed

I. Surveying — The science of determining the dimensions and contours of the earth's surface by measurements of distances, directions, and elevations; computations of areas and volumes; and the preparation of necessary maps

J. Zoning — A type of construction restriction that regulates the type of construction permitted in a specified area

II. Types of surveying for construction projects

(NOTE: Construction sites must be surveyed before the location of structures can be decided. The land is measured, features are located, and the information is used to draw maps that accurately describe the site. A later survey sets the exact location of the structure.)

A. Land or boundary survey — Locates property corners and boundary lines.

B. Topographic survey — Locates elevations and features on the land, both natural and artificial.

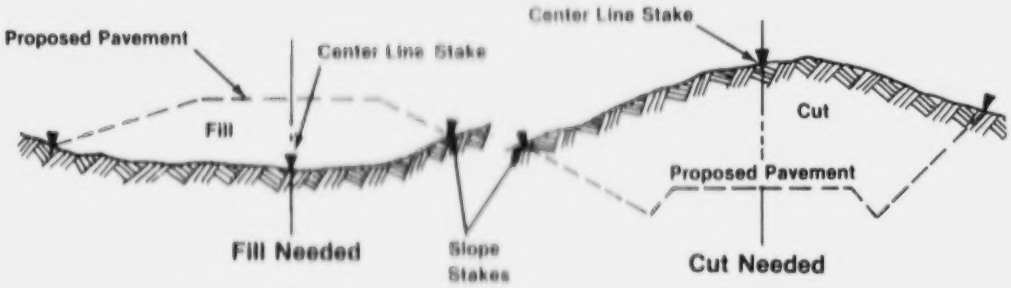
C. Route survey

1. Used for linear projects such as highways, pipelines, and power lines.

INFORMATION SHEET

2. Uses stakes to locate the center line, the width, the slope of the proposed project, and the amount of cut or fill needed.

FIGURE 1



D. Construction survey

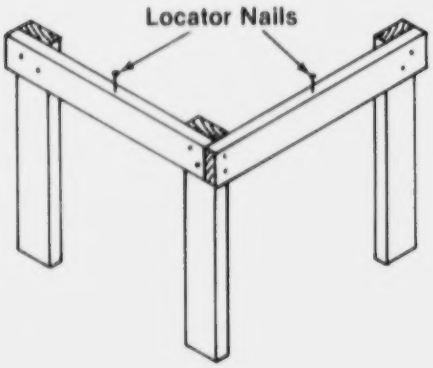
1. Is performed at a construction site to establish building lines, elevations of excavations, fills, foundations, and floors.

2. The structure's location is marked on site. The marks are used to set control points.

   (NOTE: Control points are placed wherever they are safe from construction equipment. Horizontal and vertical distances are measured from the control points.)

3. Batter boards are built outside the corners of the planned building walls. Nails or saw cuts are used to mark the locations of the walls. (Job Sheet #2)

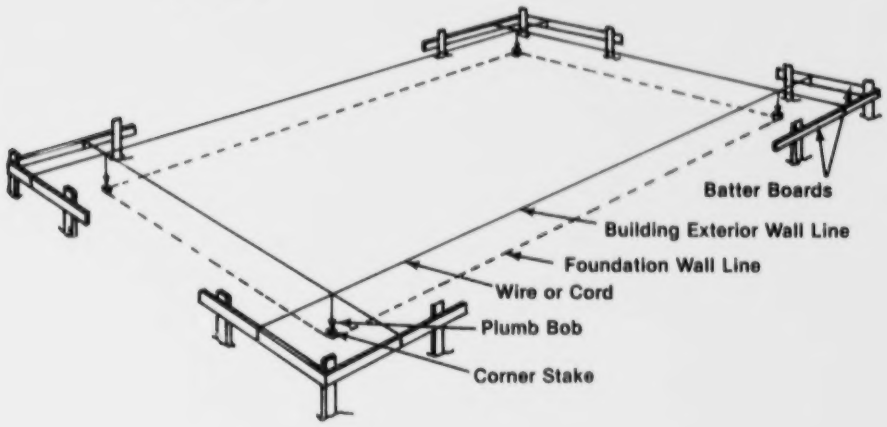
FIGURE 2



INFORMATION SHEET

4. Wires or cords are stretched between the batter board markers to show the location of the exterior walls of the building.

FIGURE 3

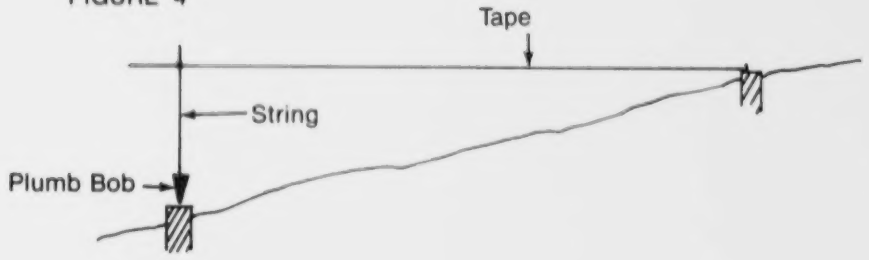


III. **Basic surveying equipment and their uses** (Transparencies 1 and 2)

A. Tapes — Used to measure horizontal distances.

B. Plumb bobs — Solid brass weights used in taping to transfer from tape to ground when above ground and to maintain horizontal alignment when measuring distances.

FIGURE 4



C. Levels — Used to establish the elevation of different points on the ground; several types are used.

1. Hand level
2. Dumpy level
3. Self-leveling level

(NOTE: New laser devices are now being used on levels which send out intense light used for leveling and alignment.)

INFORMATION SHEET

D. Level rod — A straight rod or bar with a flat face graduated in linear units with zero at the bottom, used in measuring the vertical distance between a point on the ground and the horizontal line of sight of a leveling instrument.

E. Transit — Used primarily for measuring elevations, horizontal and vertical angles and distances, and for laying out boundaries and building lines.

F. Theodolite — Accomplishes the same tasks as a transit through optical means that are more accurate.

G. Electronic distance meter (EDM) — Electronic device that emits a signal of electromagnetic energy from a position to a receiver at another position. The signal is returned from the receiver to the instrument such that two times the distance between the two positions can be measured. Very accurate.

H. Tripod — Three-legged stand for holding a leveling instrument secure.

I. Field books — Used for recording survey notes and layout and construction data.

IV. **Major parts of a level** (Transparency 3 and Job Sheet #1)

(NOTE: The following parts are for a "dumpy level", but the basic parts are quite similar to those in many other types of levels.)

A. Eyepiece focusing ring

B. Telescope

C. Objective focusing screw

D. Sunshade

E. Level vial (contains leveling bubble)

F. Level bar

G. Leveling head

H. Leveling screws

I. Base plate

V. **Types of contractors and their duties** (Transparency 4)

A. General contractors — Submit bids for contracts and obtain the services of subcontractors to do specialized work. Oversee the construction from beginning to end.

B. Subcontractors — Do specialized work, such as earthmoving, concrete, electrical, plumbing, framing, finishing, carpentry, etc.

INFORMATION SHEET

VI. General types of contracts

A. Fixed price contract

B. Cost-plus-a-fixed-fee

C. Cost-plus-a-percentage-of-cost

D. Incentive contract

(NOTE: Cost-plus-a-fixed-fee contracts are common. Cost-plus-a-percentage-of-cost contracts are used only in private industry.)

VII. Steps in securing a contract

A. **Advertise** — The owner advertises a job with an invitation to bid.

B. **Receive bids** — Contractors complete bidding documents which are then submitted to the owner.

C. **Open bids** — The owner considers the bids of qualified contractors.

D. **Award contracts** — The owner awards the contract to the contractor with the lowest responsible bid. The agreement is signed by the contractor, and then sent to the owner to be signed.

(NOTE: Sometimes owners and contractors negotiate contracts. They decide on the terms and the price.)

E. **Secure bonds** — Bonds are also sent with the contract. These assure the owner the work will be completed as promised.

F. **Sign agreement** — This is a statement of the work to be done under the contract, such as plans, specifications, instructions to bidders, general and specific conditions, bonds, and prices. Both contractor and owner sign this.

G. **Notice to proceed** — After the agreement is signed, the owner issues the notice to proceed. This gives the contractor permission to begin the work.

VIII. Steps in scheduling construction

A. Analyze the job — The contractor plans the best use of people, materials, equipment, and money.

(NOTE: Figure 5 shows an example of a plan for constructing a walkway.)

INFORMATION SHEET

FIGURE 5

MAVCC WALKWAY PROJECT			
Item	**Cost**	**% of Job**	**Time**
—Order supplies and equipment	$400	50%	2 days
—Prepare ground (excavate, etc.)	50	7	1
—Build forms	50	7	2
—Place reinforcement	100	12	1
—Order concrete			1
—Place and harden concrete	100	12	2
—Remove forms and clean up site	100	12	1
Total	$800	100%	10 days

B. Prepare a work schedule — Contractors use various methods to plan the order of work.

1. Bar graph procedure

FIGURE 6

MAVCC Walkway Project

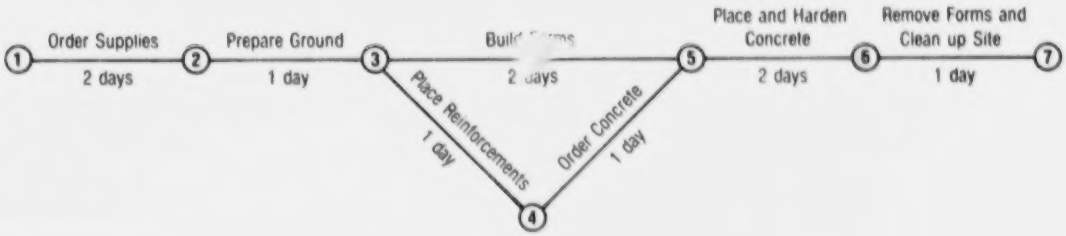
Item	Day									
	1	2	3	4	5	6	7	8	9	10
Order supplies and equipment	---	---								
Prepare ground			---							
Build forms				---	---					
Place reinforcement						---				
Order concrete							---			
Place and harden concrete								---	---	
Remove forms and clean up site										---

INFORMATION SHEET

2. Critical path method (CPM)

(NOTE: The CPM arranges the construction process in order of occurrence. Straight arrows show work which must be completed before another process begins. Diagonal arrows schedule work which can be completed at the same time.)

FIGURE 7



C. Submit schedule to supervising architect or engineer.

D. Monitor the job progress — Once the job has begun, the contractor compares scheduled and actual progress, reassigns tasks if necessary, monitors cost, and reports job progress.

FIGURE 8

MAVCC Walkway Project

Item	Day 1	2	3	4	5	6	7	8	9	10
Order supplies and equipment	- - -	- - -								
Prepare ground			- - -							
Build forms				- - -	- - -					
Place reinforcement						- - -				
Order concrete							- - -			
Place and harden concrete								- - -	- - -	
Remove forms and clean up site										- - -

Scheduled progress - - -
Actual progress ——

INFORMATION SHEET

E. Revise schedule — There are times when schedules must be changed.

Examples: Bad weather, strikes, fires on construction site, equipment failures, materials not delivered on time, alteration in plans by owner, architect, or engineer

F. Reach goal — Complete the job on or before the scheduled date.

IX. Procedures required when preparing to build

A. Secure permits and license from appropriate governing agency.

1. Building permit — For new construction, additions, or alterations.

2. Special permits — For moving heavy equipment to and from construction sites.

B. Plan and provide safety for workers and public and protection of tools, equipment, and materials on the site.

C. Construct temporary and sanitary facilities.

(NOTE: Weather can cause serious problems in construction projects. Workers, materials, and equipment must be protected from weather.)

D. Provide utilities (electricity, communication lines, water, and waste disposal).

E. Clear the site.

(NOTE: Before temporary facilities can be placed and actual construction can begin, the site usually needs to be cleared.)

X. Site clearing methods and their descriptions

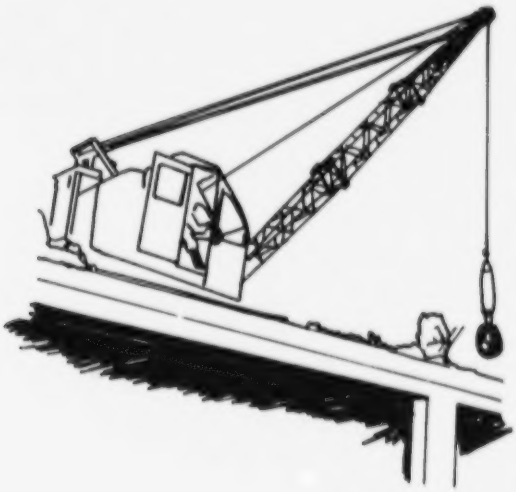
A. Demolishing (destroying)

1. Blasting — Using plastic explosives that permit smaller, better-controlled blasts.

INFORMATION SHEET

2. Wrecking — Using mechanical devices such as crowbars, crawler tractors with bulldozer blades, or cranes with wrecking balls.

FIGURE 9



B. Salvaging — Saving things before demolition

(NOTE: When a building is being demolished, many parts can be saved such as plumbing fixtures, doors, windows, electrical switchboards, etc.)

C. Cutting — Bringing down trees and brush

D. Earthmoving — Cutting and filling the ground to bring it to the proposed construction grade.

FIGURE 10

INFORMATION SHEET

E. Disposing — Removing unwanted materials by stockpiling, burying, spreading, or hauling away.

(NOTE: Some construction projects, such as for dams, require water removal from the construction site. This creates special problems. Caissons or cofferdams are commonly used to keep water from the work area.)

XI. Earthmoving equipment

(NOTE: Earthmoving is an important activity in construction. Soil and rock are moved to allow foundations to be placed below the surface. The earthmoving process is also used in pipeline and tunnel construction.)

A. Hand tools — Used for small jobs

1. Square-mouth shovel

FIGURE 15

2. Round-point shovel

FIGURE 16

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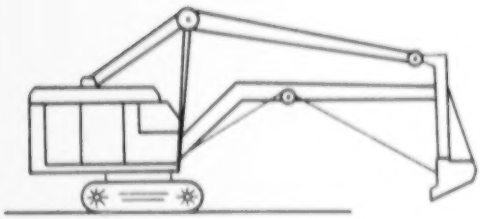
INFORMATION SHEET

3. Pick

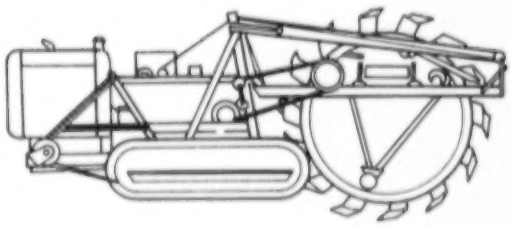
FIGURE 17

B. Power equipment — Used for different kinds of larger jobs

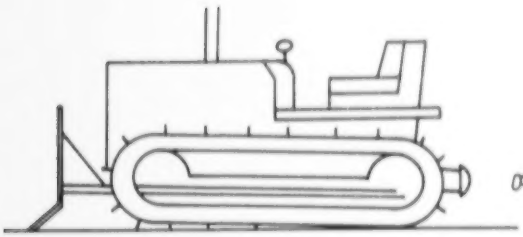
1. Backhoe



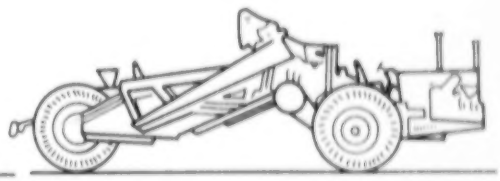
2. Trencher



3. Bulldozer



4. Scraper



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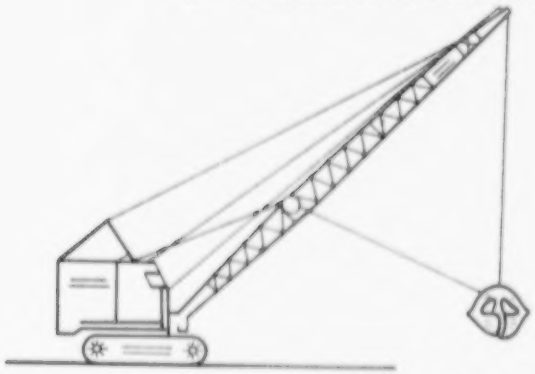
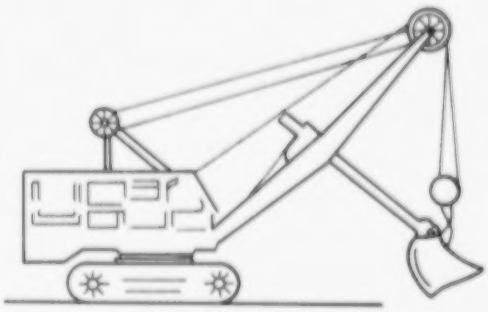
INFORMATION SHEET

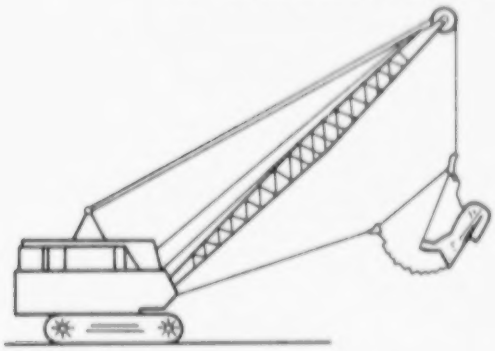
5. Crane with clamshell bucket



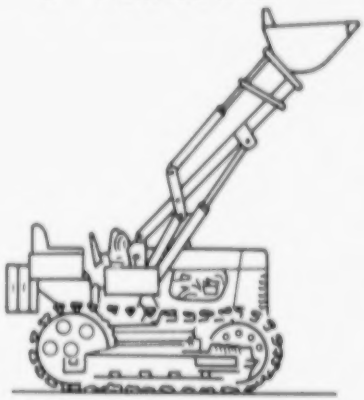
6. Power shovel



7. Crane with dragline bucket



8. Front-end loader



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XI. Types of excavating

A. Rough excavating

1. Purpose of rough excavating — To remove large amounts of earth

2. Reasons for rough excavating

   a. To reach earth that will provide a good base for the foundations of structures

   b. To build basements of houses and other buildings

   c. To make cuts through hilly land for travel routes

   d. To smooth uneven ground

3. There are many ways to perform rough excavating such as trenching, dredging, and pit excavating depending on the specific reason for excavating and special conditions that may exist.

INFORMATION SHEET

B. Finish excavating

1. Trimming and shaping — Usually done in the rough excavated bed or wall. There are several ways to do it such as cleaning and washing, grading, sloping, and treating.

2. Stabilizing — Used to support structures that may have been weakened by the rough excavating. Earth and structure may need to be held in position. There are several ways to stabilize:

   a. Compacting — The process of compressing the earth to make it firm. Rollers are used to pack the earth.

   b. Sheathing — Forms walls to keep earth out of the excavated area. A frame work holds the sheathing commonly made of wood planks and wood or metal panels.

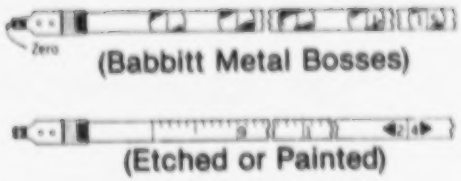
   c. Bracing and shoring — Commonly used in narrow excavations to support sheathing materials.

   d. Piling — Large concrete, steel, or wooden piles driven into the ground to give stability to a structure. Piling also prevents structures from settling unevenly.

   e. Cofferdamming — Sheets of wood, steel, or concrete are driven into the ground to form a watertight wall around a work site. Water or other material is removed so construction can be done in a dry space.

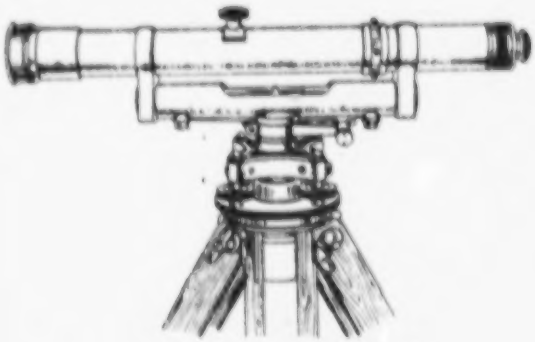
   f. Soil conditioning — The process of using additives (lime, gypsum) to make the soil more usable.

Surveying Equipment

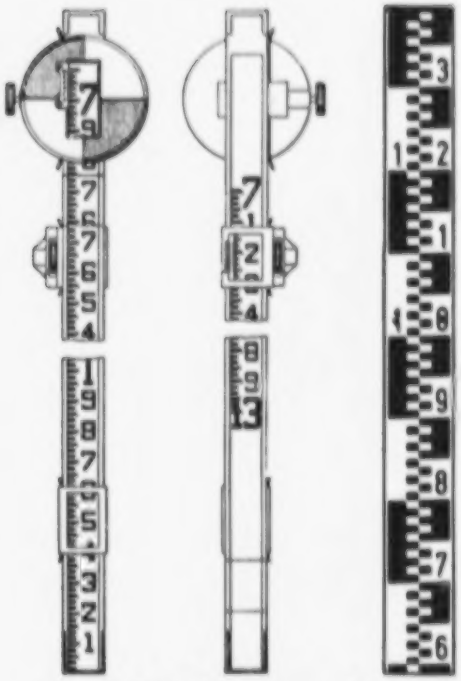


Tapes (Steel)

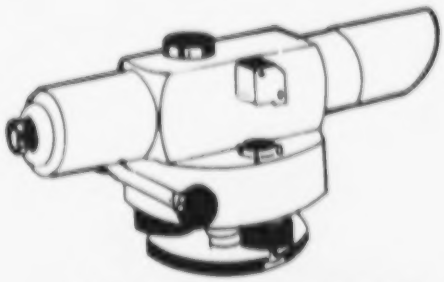
Hand Level



Dumpy Level

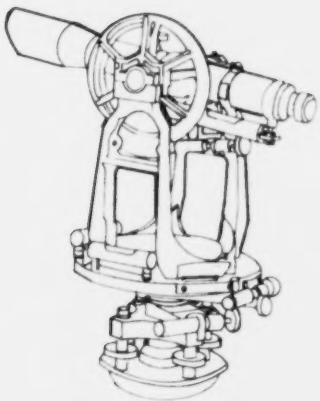


Level Rods

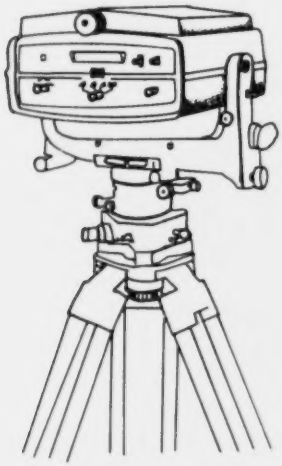


Self-Leveling Level

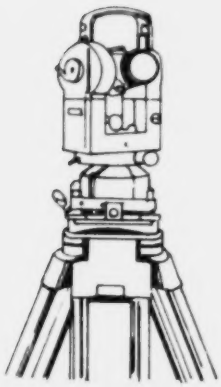
Surveying Equipment
(Continued)



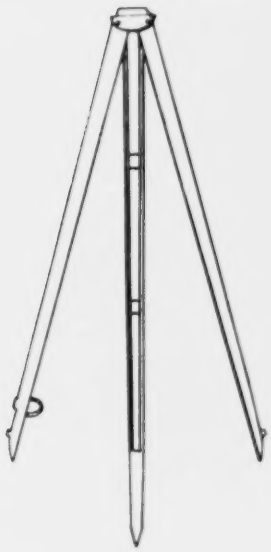
Transit



EDM

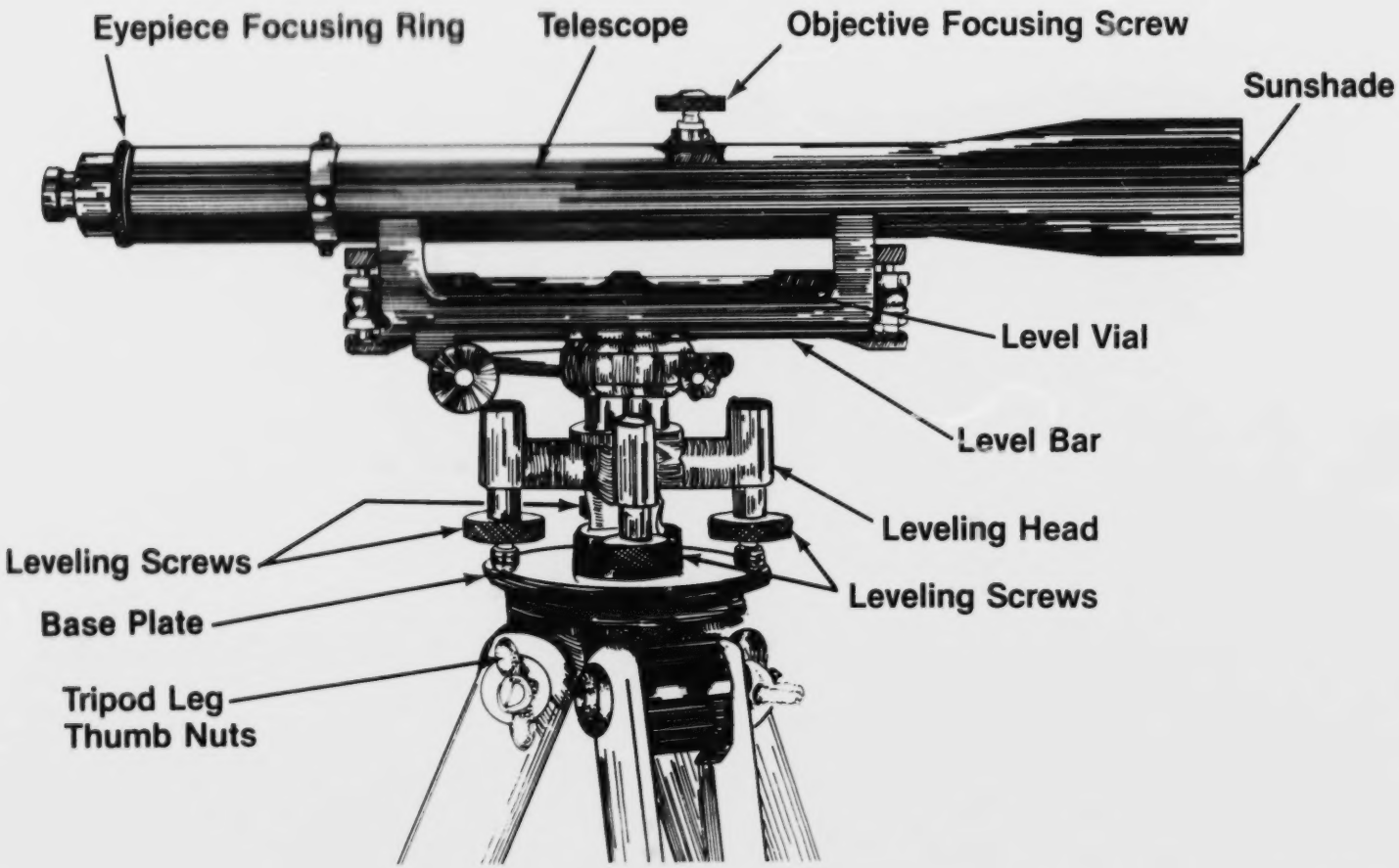


Theodolite



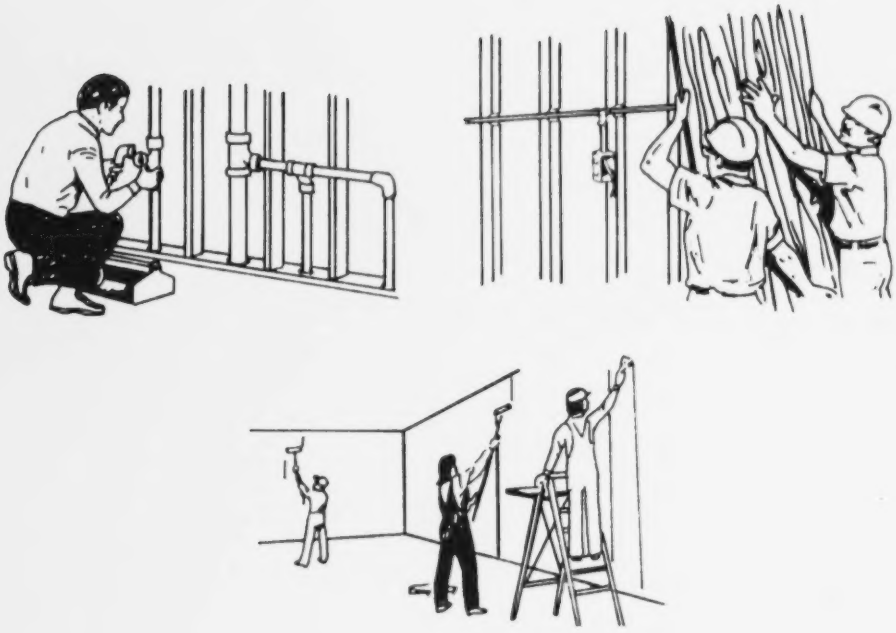
Tripod

Parts of a Level



Types of Contractors

General Contractor



Subcontractors

CONSTRUCTION PREPARATION
UNIT IV

ASSIGNMENT SHEET #1 — PLAN TO CLEAR THE SITE

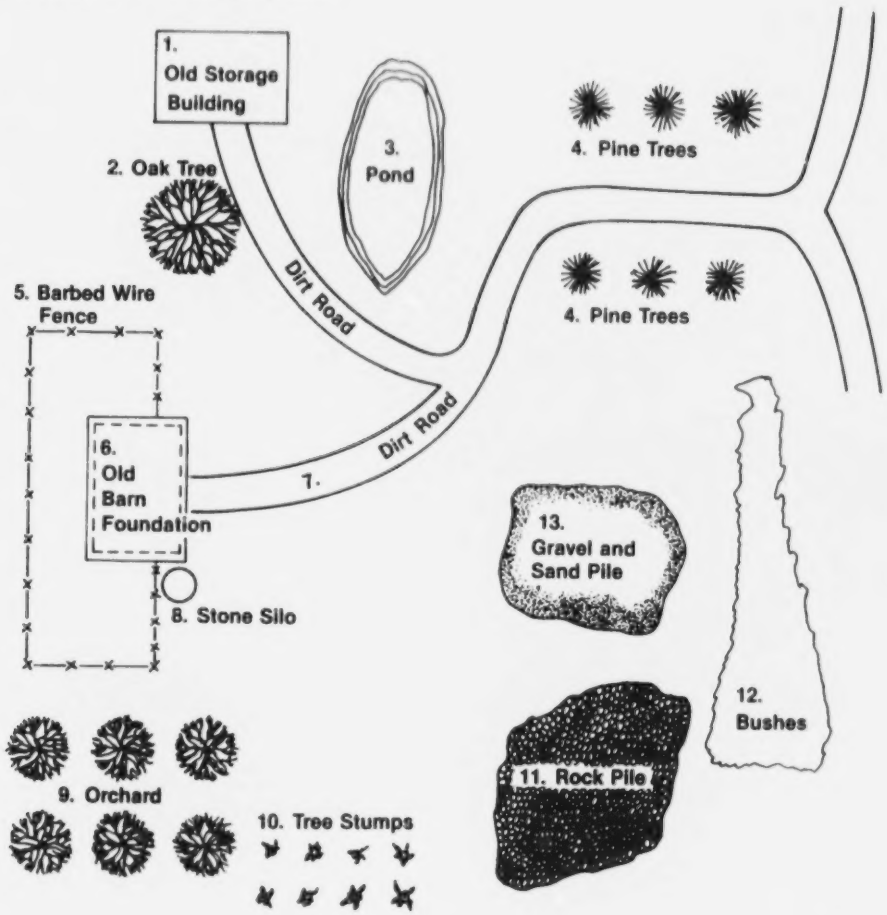
NAME _____ SCORE _____

Directions:

1. Set up the site box frame constructed in Unit I, Job Sheet #1.

2. Place the topographic features as shown in Figure 1. You may use models for bushes, trees, fences, rocks, and tree stumps, aluminum foil for the pond, paper towel roll for silo, and cardboard boxes for barn and storage buildings.

FIGURE 1 — Existing Site

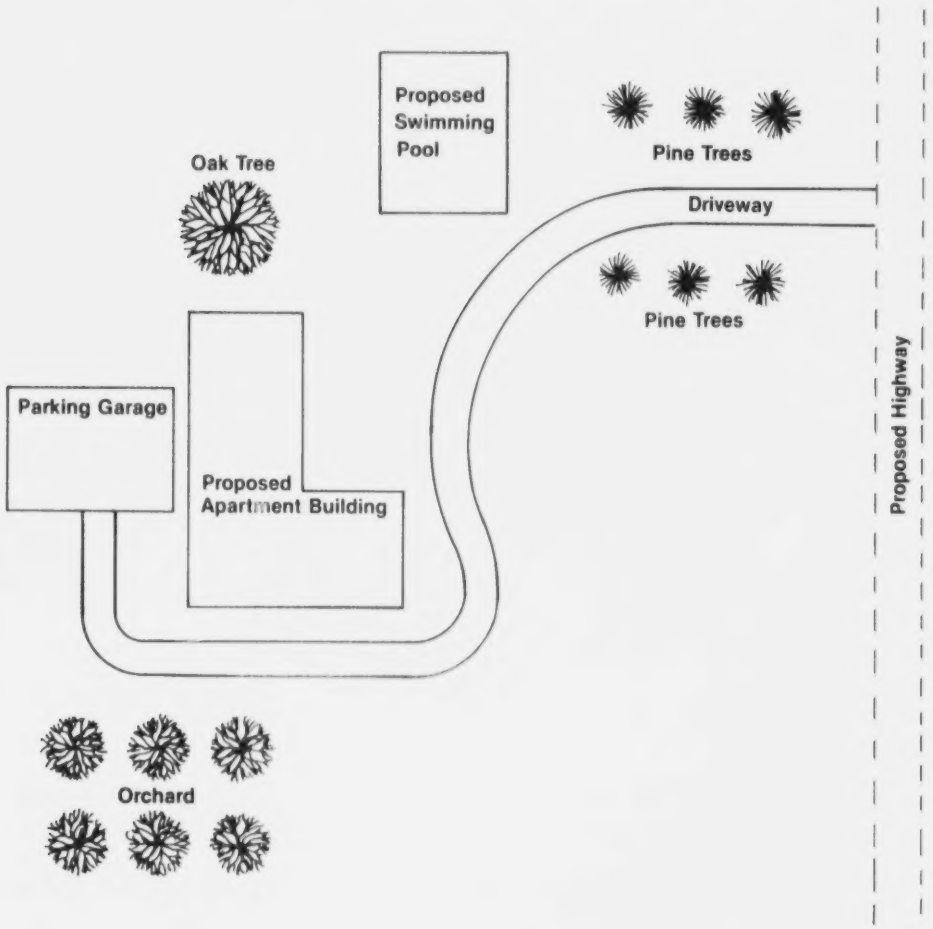


ASSIGNMENT SHEET #1

3. Study Figure 2, the proposed construction project. Compare it with Figure 1, the existing site. Find obstacles that will be in the way or unsightly for new project.

4. Next, complete the chart on the following page by deciding what site clearing procedures will be used to remove the obstacles and what equipment will be required. Clean up the site box after finishing chart.

FIGURE 2 — Proposed site



ASSIGNMENT SHEET #1

SITE CLEARING CHART

Topographic Features	Reason for Clearing			Procedure to Clear Site						Equipment Required										
	In Way of Planned Construction	Unsightly	OK–Clearing not needed	Demolishing	Salvaging	Cutting	Burning (if allowed)	Earthmoving	Disposing	Axes	Saws	Crowbars	Crane with Wrecking Ball	Crawler Tractor with Bulldozer Blade	2 Crawler Tractors with Chains	Matches	Explosives	Dump Truck	Sump Pump	Crawler Tractor with Bucket
1. Old storage building																				
2. Oak tree																				
3. Pond																				
4. Pine trees																				
5. Fence																				
6. Foundation of old barn																				
7. Existing dirt road																				
8. Stone silo																				
9. Orchard																				
10. Tree stumps																				
11. Rock pile																				
12. Bushes																				
13. Gravel and sand pile																				

CONSTRUCTION PREPARATION
UNIT IV

ASSIGNMENT SHEET #2 — ESTIMATE A SITE CLEARING PROJECT

NAME _____ SCORE _____

Directions: Work in a group and plan to clear a site.

1. Study the project diagram. (Figure 2) The site is to be cleared for an apartment building. Some obstacles must be moved before construction can begin. You will need pencils and 12" rules for each student.

2. Determine what to do with each obstacle. The choices are as follows:

   a. Use excess material for fill needed on the site. This requires a $25 equipment rental fee per load to move the material.

   b. Salvage some materials and sell them. This may be more economical than burning. The cost of hauling the salvaged materials is $25 per load.

   c. Burn some excess materials such as wood. This requires a $5 burning permit for each obstacle. Also, a $25 *per obstacle* (not per load) rental charge is required for equipment to spread the ashes.

   d. Haul the excess material off the site. This costs $25 per load for equipment.

3. Use the following procedure to record your decisions: (Figure 1)

   a. In one of the dashed boxes near the obstacle, record the number of loads of material to be removed.

   b. Using a rule, neatly draw an arrow from this box to the place where the material will be disposed.

   c. In the dashed box near the point where the obstacle was placed, record the number of loads.

4. Figure the on-site cost of transporting materials by calculating the cost of each move. This can be done along the arrow. Record each on-site transportation cost in the "On-Site Hauling Costs" table.

5. Complete the other tables following the project diagram. Obtain Totals A, B, C, D, and E.

6. Complete the "Salvaging Cost Summary" table on the last page of this assignment.

ASSIGNMENT SHEET #2

7. Compare your group's net expenses with net expenses of other groups. Why were your expenses greater or less than expenses of other groups?_____

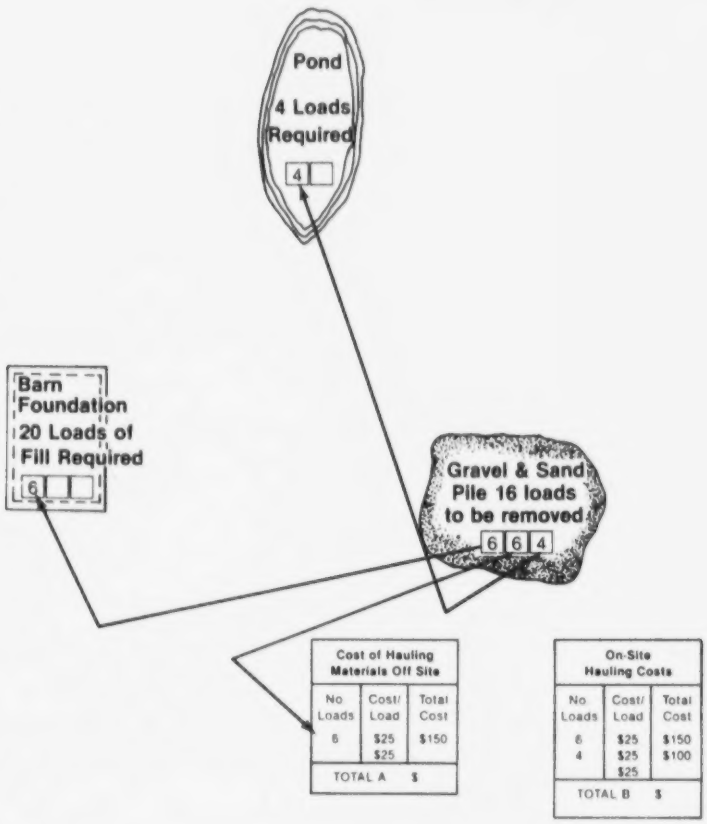
_____

_____

_____

8. Clean up area.

FIGURE 1

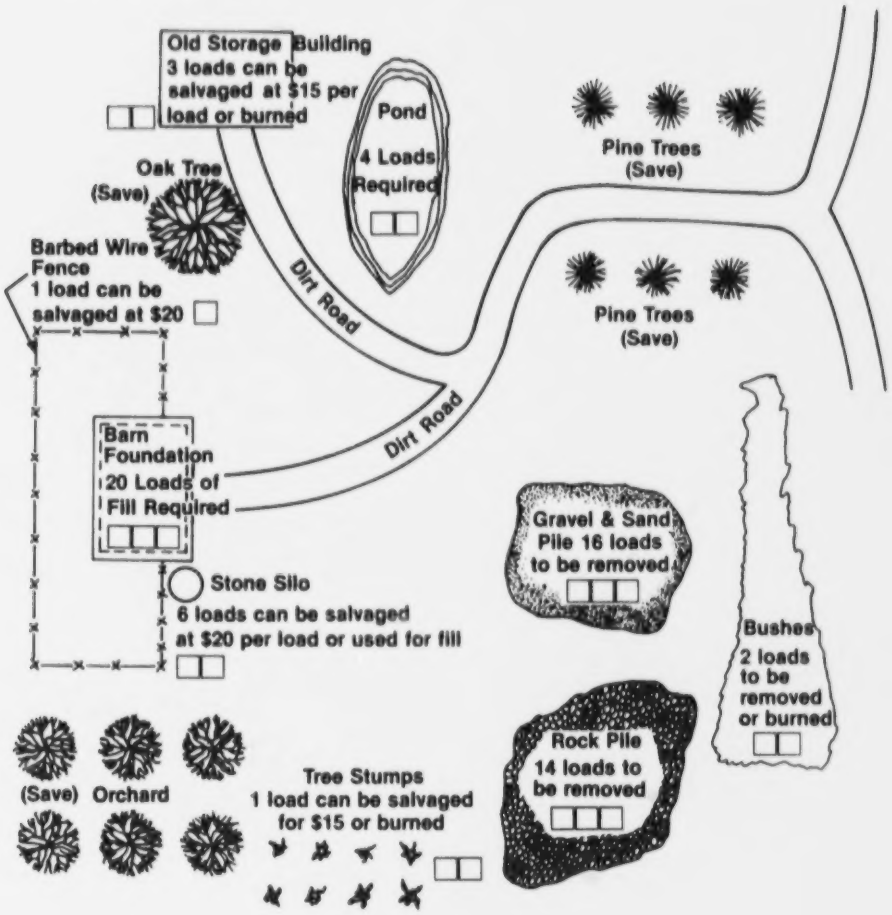


Cost of Hauling Materials Off Site		
No. Loads	Cost/ Load	Total Cost
6	$25	$150
	$25	
TOTAL A		$

On-Site Hauling Costs		
No. Loads	Cost/ Load	Total Cost
6	$25	$150
4	$25	$100
	$25	
TOTAL B		$

ASSIGNMENT SHEET #2

FIGURE 2


Old Storage Building
3 loads can be salvaged at $15 per load or burned
Pond
4 Loads Required
Pine Trees (Save)
Oak Tree (Save)
Barbed Wire Fence
1 load can be salvaged at $20
Dirt Road
Pine Trees (Save)
Dirt Road
Barn Foundation
20 Loads of Fill Required
Gravel & Sand Pile 16 loads to be removed
Stone Silo
6 loads can be salvaged at $20 per load or used for fill
Bushes
2 loads to be removed or burned
(Save) Orchard
Tree Stumps
1 load can be salvaged for $15 or burned
Rock Pile
14 loads to be removed

Tables

Cost of Hauling Materials Off Site		
No. Loads	Cost/ Load	Total Cost
	$25	$
	$25	$
TOTAL A		$

On-Site Hauling Costs		
No. Loads	Cost/ Load	Total Cost
	$25	$
	$25	$
	$25	$
	$25	$
TOTAL B		$

Burning Costs			
No. Loads	Building Permit	Spreading Costs	Total Cost
	$5	$25	$
	$5	$25	$
TOTAL C			$

Materials Salvaged and Sold				
No. Loads	Hauling Cost/Load	Total Cost	Price/ Load	Total Income
	$25	$	$	$
	$25	$	$	$
	$25	$	$	$
	$25	$	$	$
TOTAL D		$	TOTAL E	$

ASSIGNMENT SHEET #2

Salvaging Cost Summary

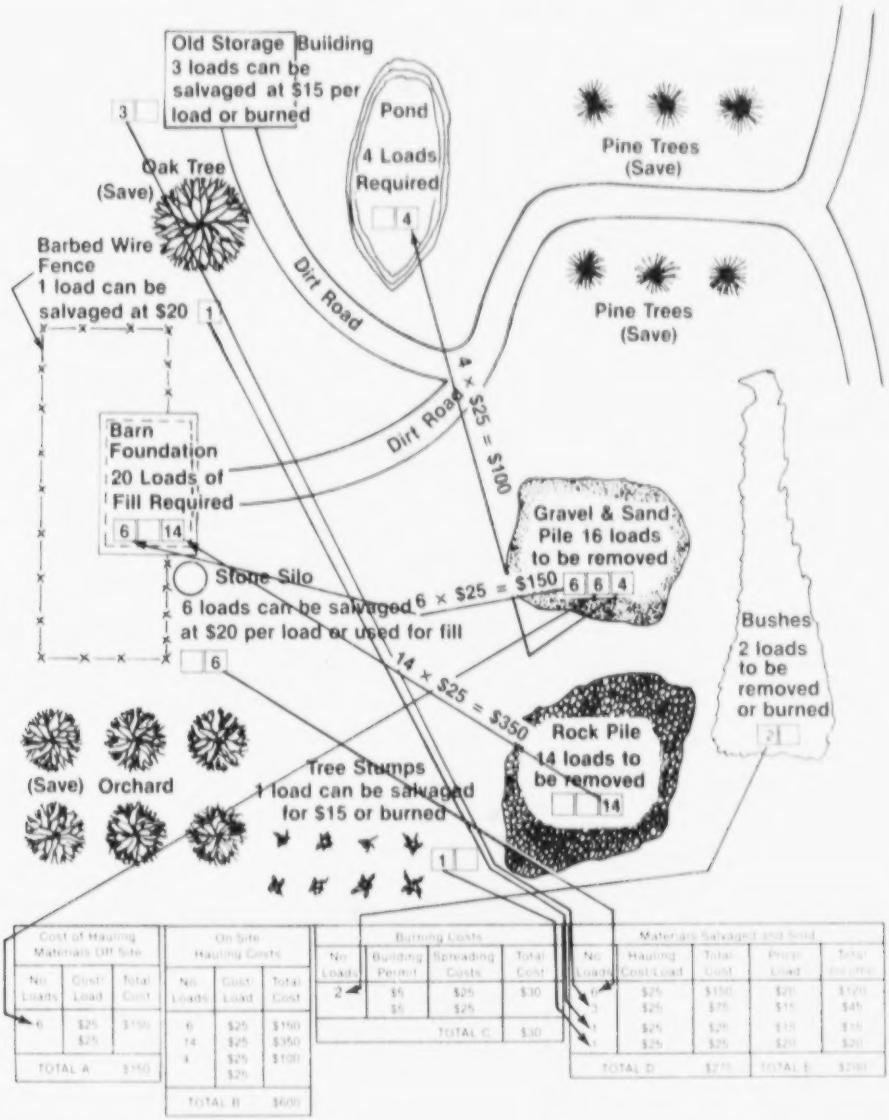
	TOTAL A	$ _____
	TOTAL B	$ _____
	TOTAL C	$ _____
+	TOTAL D	$ _____
=	GROSS EXPENSES	$ _____
–	TOTAL E	$ _____
=	NET EXPENSES	$ _____

CONSTRUCTION PREPARATION
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor.

Assignment Sheet #2 — Answers may vary. One solution is as follows:



ASSIGNMENT SHEET #2

Salvaging Cost Summary

	TOTAL A	$ 150
	TOTAL B	$ 600
	TOTAL C	$ 30
+	TOTAL D	$ 275
=	GROSS EXPENSES	$1055
–	TOTAL E	$ 200
=	NET EXPENSES	$ 855

CONSTRUCTION PREPARATION
UNIT IV

JOB SHEET #1 — SET UP AND ADJUST A LEVEL

A. Equipment

1. Level in carrying case
2. Tripod

B. Procedure

1. Set leg shoes of the two nearest tripod legs in ground about 3 feet apart. (Figure 1)
2. Swing third leg out to form a triangle, placing legs on ground so that the head plate is nearly level. (Figure 1)

   (NOTE: If the ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two tripod legs on downhill or uneven side.)

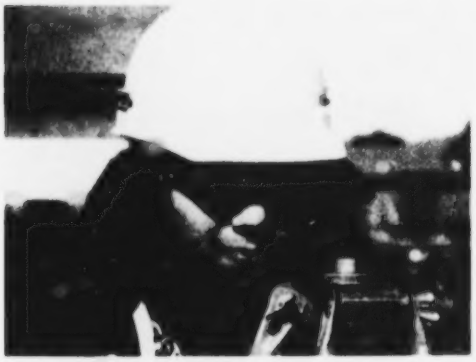
   FIGURE 1

3. Tighten leg thumb nuts.

JOB SHEET #1

4. Check tripod's head plate to assure that it is level. (Figure 2)

FIGURE 2



5. Remove level from carrying case by lifting level bar. (Figure 3)

(NOTE: Never grasp the telescope barrel while removing instrument from carrying case.)

FIGURE 3

JOB SHEET #1

6. Attach level to tripod. (Figure 4)

   (NOTE: Keep a firm grip on instrument until it is securely in position on tripod.)

   FIGURE 4

7. Remove dust cap from lens and place cap in carrying case.

   (NOTE: Between uses, keep the dust cap in place to protect the lens from dust or scratches.)

8. Attach sunshade to instrument if sunshade is not a permanent attachment.

9. Align telescope barrel directly over one pair of leveling screws.

   (NOTE: The leveling screws will be used as the name indicates: to level the instrument.)

10. Rotate leveling screws by moving your thumbs in opposite directions until bubble is centered in level vial. (Figure 5)

    FIGURE 5

JOB SHEET #1

11. Turn instrument clockwise 90° to align barrel over the other pair of leveling screws.

12. Rotate leveling screws by moving your thumbs in opposite directions until bubble is centered in level vial. (Figure 6)

FIGURE 6

13. Turn instrument clockwise 90° to bring it parallel with first pair of leveling screws; center bubble again. (Figure 7)

FIGURE 7

14. Turn instrument clockwise 90° to bring it parallel with second pair of leveling screws; center bubble again.

(NOTE: Bubble should stay in center regardless of direction the telescope is pointing. If bubble does not stay in center, instrument is out of level and should be adjusted by competent personnel. Avoid touching tripod after instrument is level. If instrument creeps off level or is bumped during use, stop and reset tripod, relevel instrument, and start again from last known good bench mark.)

JOB SHEET #1

15. Turn eyepiece focusing ring until cross hairs appear clear and sharp. (Figure 8)

(NOTE: The target may not be in focus, but you should be able to focus the cross hairs using the eyepiece focusing ring.)

FIGURE 8

16. Rotate objective focusing screw to bring target into sharp focus. (Figure 9)

(NOTE: When cross hairs and target are in sharp focus, you should be able to read a rod accurately.)

FIGURE 9

17. When finished with sighting, replace lens dust-cap, remove level from tripod, and store level in carrying case.

18. Store carrying case and tripod.

CONSTRUCTION PREPARATION
UNIT IV

JOB SHEET #2 — LOCATE A STRUCTURE

A. Tools and materials

1. Bill of material

Quantity	Item	Size	Unit Cost	Cost
1	Ball of string			
1	Site box (Unit I, JS#1)			
?	Sand (enough to half fill the site box)			
74	Box nails	6d		
20	Boards	1 × 2 × 12″		

2. Each group will need the following tools:

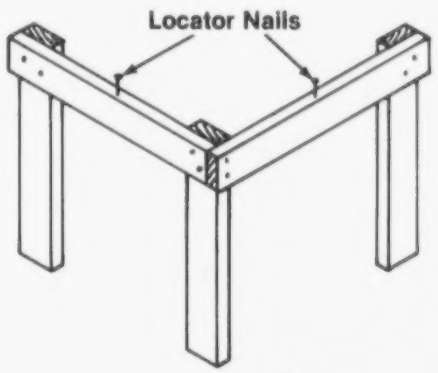
2	Hammers
1	Pair scissors
1	Plumb bob
1	12″ Rule
1	Try square

(CAUTION: Wear safety glasses when nailing.)

B. Procedure

1. Assemble the batter boards as shown below. Four sets are needed.

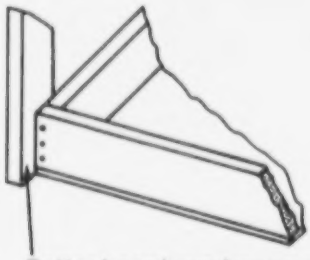
FIGURE 1



JOB SHEET #2

a. Nail the batter boards to the site box as shown below.

FIGURE 2



Batter board overhangs site box
by one thickness of board

b. Assume the building outline will be 8" from the inside of the batter boards. Measure and mark the batter boards for locator nails. Refer to Figure 1.

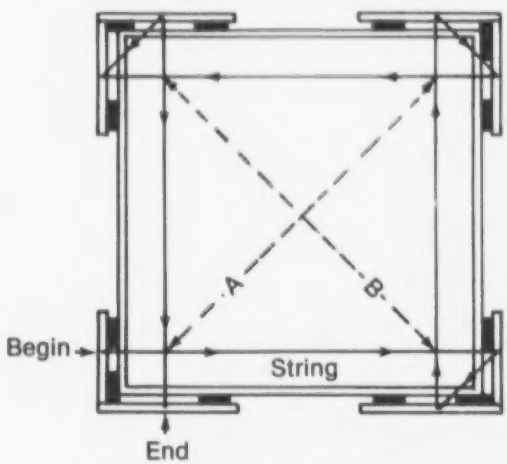
c. Drive these nails only part way in. There should be room to tie strings to them.

d. Use try square to check corners for squareness.

2. Locate and check the building lines.

a. Stretch a string on locator nails as shown below.

FIGURE 3



(NOTE: The strings locate the outside walls of the building.)

JOB SHEET #2

b. Check the squareness by measuring from corner to corner. See Figure 3. Diagonal A should equal Diagonal B.

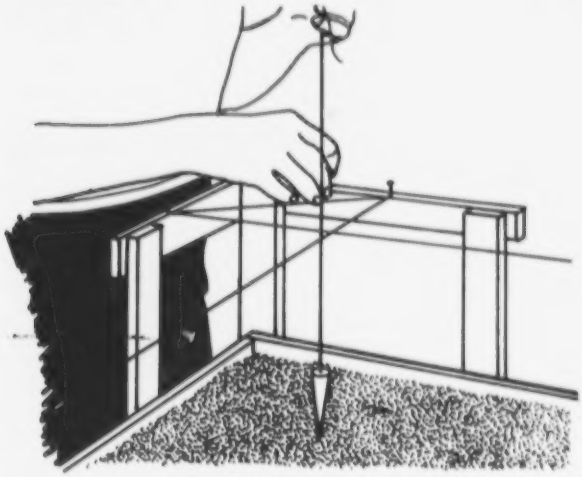
3. Locate the four corner ground points.

a. Using the plumb bob, find the exact corner ground points. Use this method:

1) Place the plumb bob at the intersection of the strings.

2) Slowly lower the plumb bob until it just touches the sand.

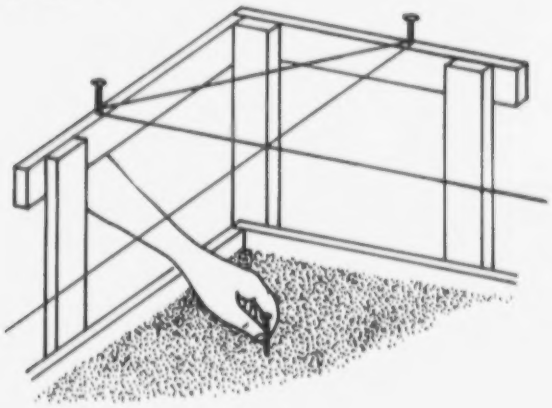
FIGURE 4



b. Mark the corner with a 6d nail.

(NOTE: This represents a small stake.)

FIGURE 5



JOB SHEET #2

c. Do this for all four corners.

4. Clean up as directed. Your instructor may direct you to remove and disassemble batter boards.

CONSTRUCTION PREPARATION
UNIT IV

PRACTICAL TEST
JOB SHEET #1 — SET UP AND ADJUST A LEVEL

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Properly positioned tripod and tightened thumb nuts.	_____	_____
3. Checked to make sure tripod was level.	_____	_____
4. Correctly removed level from case.	_____	_____
5. Attached level to tripod.	_____	_____
6. Removed dust cap and added sunshade if needed.	_____	_____
7. Centered bubble in level vial 4 times.	_____	_____
8. Focused cross hairs using eyepiece ring.	_____	_____
9. Focused target using focusing screw.	_____	_____
10. Checked in/put away tools and materials.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Tripod is level				
	4	3	2	1
Instrument is level				
	4	3	2	1
Cross hair is focused				
	4	3	2	1
Target is focused				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PREPARATION
UNIT IV

PRACTICAL TEST
JOB SHEET #2 — LOCATE A STRUCTURE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Put on proper protective gear, as required.	_____	_____
3. Assembled batter boards.	_____	_____
4. Stretched string correctly over locator nails.	_____	_____
5. Used a plumb bob to locate and mark the four corner ground points.	_____	_____
6. Checked in/put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Practiced safety rules throughout procedure.	_____	_____
10. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Batter boards are square				
	4	3	2	1
Corner points are correct				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PREPARATION
UNIT IV

NAME _____ SCORE _____

TEST

1. Match the terms on the right with the correct definitions.

_____a.	People who manage construction by identifying work to be done and the people and materials to do it	1. Bench mark
_____b.	Leveling instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels	2. Builder's level
_____c.	Stake driven into ground at proposed grade	3. Contractors
_____d.	A type of construction restriction that regulates the type of constructed permitted in a specified area	4. Cross hairs
_____e.	Permanent point of known or assumed elevation	5. Elevation
_____f.	Fine horizontal and vertical lines in telescope of leveling instrument; used as reference lines in the field or for marking instrumental axis	6. Grade
_____g.	The science of determining the dimensions and contours of the earth's surface by measurements of distances, directions, and elevations; computations of areas and volumes; and the preparation of necessary maps	7. Grade stake
		8. Scheduling
		9. Surveying
		10. Zoning

TEST

2. Distinguish between the types of surveying for construction projects by placing the following letters next to the correct descriptions.

   - C — Construction survey
   - L — Land (or boundary) survey
   - R — Route survey
   - T — Topographic survey

   _____a. Used for linear projects such as highways, pipelines, and power lines.

   _____b. Locates property corners and boundary lines.

   _____c. Locates elevations and features on the land, both natural and artificial.

   _____d. Is performed at a construction site to establish building lines, elevations of excavations, fills, foundations, and floors.

3. Match basic surveying equipment on the right with the correct uses.

   _____a. Accomplishes the same tasks as a transit through optical means that are more accurate.

   _____b. Three-legged stand for holding a leveling instrument secure.

   _____c. Used for recording survey notes and layout and construction data

   _____d. Used to measure horizontal distances.

   _____e. Solid brass weights used in taping to transfer from tape to ground when above ground and to maintain horizontal alignment when measuring distances.

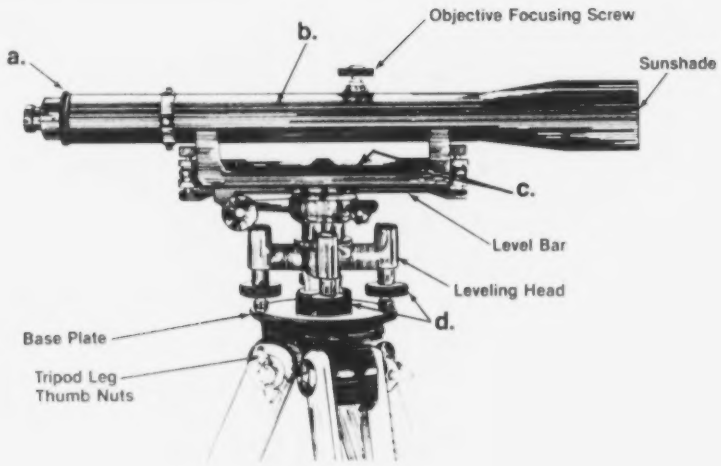
   _____f. Used to establish the elevation of different points on the ground; several types such as hand and dumpy are used.

   _____g. Used primarily for measuring elevations, horizontal and vertical angles and distances, and for laying out boundaries and building lines.

   1. Electronic distance meter (EDM)
   2. Field books
   3. Level rod
   4. Levels
   5. Plumb bobs
   6. Tapes
   7. Theodolite
   8. Transit
   9. Tripod

TEST

4. Identify the major parts of a level.



a. _____ b. _____

c. _____ d. _____

5. Distinguish between the types of contractors by placing an "X" next to the description of general contractors.

_____a. Submit bids for contracts and obtain the services of others to do specialized work. Oversee the construction from beginning to end.

_____b. Do specialized work, such as earthmoving, concrete, electrical, plumbing, framing, finishing, carpentry, etc.

6. Select from the following list the general types of contracts by placing an "X" in the appropriate blanks.

_____a. Fixed price contract

_____b. Cost-plus-a-fixed-fee

_____c. Cost only

_____d. Cost-plus-a-percentage-of-cost

TEST

7. Arrange in order the steps in securing a contract by placing the correct sequence numbers (1-7) in the appropriate blanks.

_____a. Secure bonds

_____b. Sign agreement

_____c. Receive bids

_____d. Notice to proceed

_____e. Open bids

_____f. Advertise

__4__g. Award contracts

8. Arrange in order the steps in scheduling construction by placing the correct sequence numbers (1-6) in the appropriate blanks.

_____a. Revise schedule.

_____b. Monitor the job progress.

_____c. Prepare a work schedule.

_____d. Reach goal.

_____e. Analyze the job.

_____f. Submit schedule to supervising architect or engineer.

9. Select from the following list the procedures required when preparing to build by placing an "X" next to the correct procedures.

_____a. Construct temporary and sanitary facilities.

_____b. Construct permanent facilities.

_____c. Clear the site.

_____d. Secure permits and license.

_____e. Landscape.

_____f. Build the foundation.

_____g. Provide utilities.

_____h. Plan and provide safety and protection (for crew and site).

_____i. Rewrite restrictive covenants as needed.

TEST

10. Match the site clearing methods on the right with the correct descriptions.

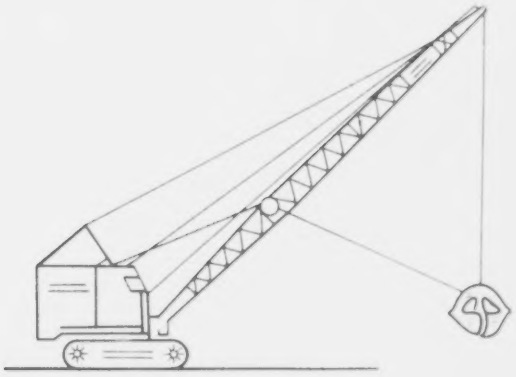
_____a.	Destroying using blasting and wrecking methods.	1. Cutting
_____b.	Saving things before demolition.	2. Demolishing
_____c.	Removing unwanted materials by stockpiling, burying, spreading, or hauling away.	3. Disposing
_____d.	Cutting and filling the ground to bring it to the proposed construction grade.	4. Earthmoving
		5. Salvaging

11. Identify the following earthmoving equipment.

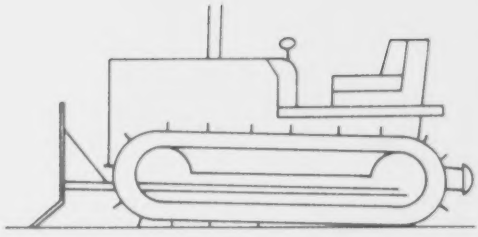
a. _____

b. _____

c. _____



d. _____



e. _____

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TEST

12. Distinguish between the types of excavating by placing an "R" next to the description(s) of rough excavating and an "F" next to those for finish excavating.

    _____a. Includes trimming, shaping, and stabilizing.

    _____b. Includes trenching, dredging, and pit excavating.

    _____c. Its purpose is to remove large amounts of earth.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Plan to clear a site. (Assignment Sheet #1)

14. Estimate a site clearing project. (Assignment Sheet #2)

15. Demonstrate the ability to:

    a. Set up and adjust a level. (Job Sheet #1)

    b. Locate a structure. (Job Sheet #2)

CONSTRUCTION PREPARATION
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 7
   d. 10
   e. 1
   f. 4
   g. 9

2. a. R
   b. L
   c. T
   d. C

3. a. 7
   b. 9
   c. 2
   d. 6
   e. 5
   f. 4
   g. 8

4. a. Eyepiece focusing ring
   b. Telescope
   c. Level vial (bubble)
   d. Leveling screws

5. a

6. a, b, d

7. a. 5
   b. 6
   c. 2
   d. 7
   e. 3
   f. 1
   g. 4

8. a. 5
   b. 4
   c. 2
   d. 6
   e. 1
   f. 3

9. a, c, d, g, h

10. a. 2
    b. 5
    c. 3
    d. 4

11. a. Pick
    b. Square mouth shovel
    c. Round point shovel
    d. Crane with clamshell bucket
    e. Bulldozer

ANSWERS TO TEST

12. a. F
    b. R
    c. R

13.-15. Evaluated to the satisfaction of the instructor

CONSTRUCTION PROCESSES
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a member of a construction crew and complete a framed construction project. Competencies will be demonstrated by completing the job sheets and the unit tests with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to construction processes with the correct definitions.
2. Label the three major parts of a foundation.
3. Identify types of foundations.
4. Match materials used for foundations with the correct descriptions.
5. Arrange in order the steps in setting foundations.
6. Match types of frames for superstructures with the correct descriptions.
7. Identify structural steel shapes used for frame construction.
8. Arrange in order the steps in constructing steel frames.
9. Complete statements concerning the steps in constructing concrete frames.
10. Arrange in order the major steps in constructing wood frames.
11. Arrange in order the steps used in erecting a structure.
12. Select from a list the outside utility systems.

OBJECTIVE SHEET

13. Complete statements concerning inside utility systems.
14. Arrange in order the sequence for roughing in the inside utility systems.
15. State reasons for insulating structures.
16. Complete a chart of the types of insulation and the methods for adding them.
17. Select from a list the common areas to insulate.
18. Complete statements concerning enclosing the exterior.
19. Complete statements concerning enclosing the interior.
20. Complete statements concerning finishing the project.
21. Demonstrate the ability to:
    a. Pour a concrete foundation. (Job Sheet #1)
    b. Build a wood frame structure. (Job Sheet #2)
    c. Rough in copper water lines. (Job Sheet #3)
    d. Rough in plastic water lines. (Job Sheet #4)
    e. Rough in electrical power systems. (Job Sheet #5)
    f. Layout and construct a roof truss. (Job Sheet #6)
    g. Frame a roof. (Job Sheet #7)
    h. Install siding. (Job Sheet #8)
    i. Enclose a roof. (Job Sheet #9)
    j. Trim the outside of a structure. (Job Sheet #10)

CONSTRUCTION PROCESSES
UNIT V

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information sheet.

F. Discuss information sheet.

G. Provide students with job sheets.

H. Discuss and demonstrate the procedure outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Determine the type and size of structure to be built.

   a. A variety of wood frame project plans are available from:

      Teco
      5530 Wisconsin Avenue
      Chevy Chase, MD 20815
      1-800-438-8326

   b. Other plans may be obtained from a local building supply or lumber company.

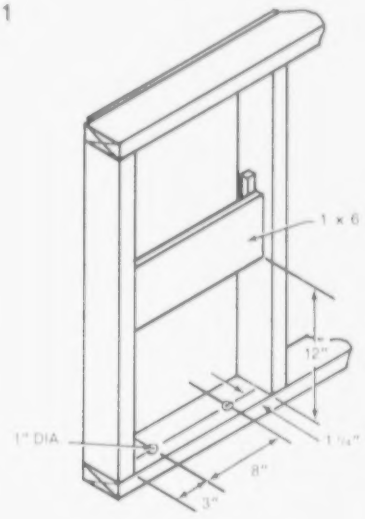
2. Determine amount of concrete work to be done.

SUGGESTED ACTIVITIES

3. Prepare or have class prepare knockdown units if the class will not be working on a full size construction project.

   (NOTE: Use double headed nails for construction of unit in order to facilitate easier teardown.)

   FIGURE 1



4. Show examples of the types of insulation. Stress its value in reducing energy costs.

5. Discuss construction safety and clean up procedures.

6. Show actual blueprints of foundation plans.

7. Plan for the students to wire a doorbell circuit if electrical wiring is not used in their project.

8. Discuss or have students incorporate drywall installation during the construction process.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction*. South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

B. Lux, Donald G., et. al. *World of Construction*. Bloomington, IL: McKnight Publishing Co., 1982.

C. Feirer, John L. and Gilbert R. Hutchings. *Guide to Residential Carpentry*. Peoria, IL: Bennett Publishing Co., 1983.

D. Reader's Digest. *Complete Do-It-Yourself Manual*, Pleasantville, NY: Reader's Digest Assoc., Inc., 1973.

E. Smith, Eddie. *Agricultural Mechanics*. Stillwater, OK: CIMC/Oklahoma State Department of Vo-Tech Education, 1977.

F. Hendrix, Laborn "Bud". *Fundamentals of Carpentry*. Stillwater, OK: A.G.C. and Oklahoma State Department of Vo-Tech Education, 1985.

G. Hendrix, Laborn "B". *Residential Carpentry*. Stillwater, OK: A.G.C. and Oklahoma State Department of Vo-Tech Education, 1985.

CONSTRUCTION PROCESSES
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Foundation — The substructure of a building that is designed to support the building

B. Girders — Extra support used to support floor joists when there is a great distance between foundation walls

C. Header (lintel) — A horizontal structural member that spans an opening in a wall and that usually carries the weight of the material over the opening

D. Joists — The horizontal members of floor or ceiling framings

E. Mechanical systems — Pipes or ducts which move heat, water, or gas throughout a structure

F. Rafters — The sloped members of a roof framing

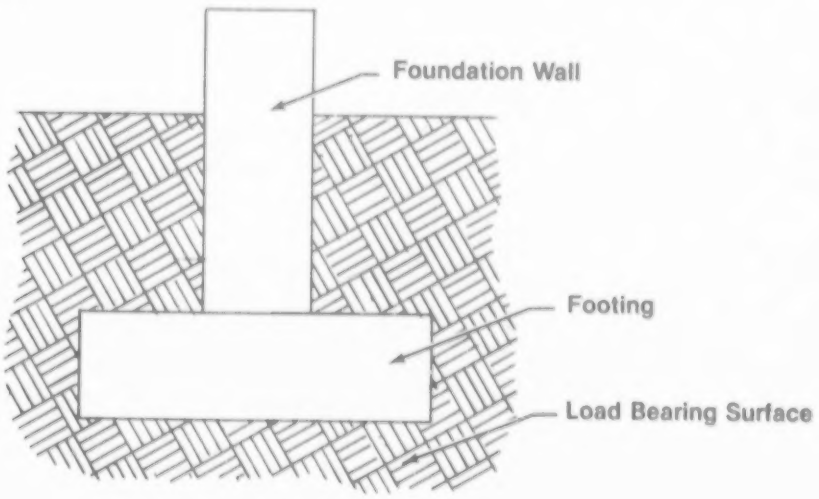
G. Reinforcement — Steel bars (rebars) or wire mesh used in concrete for additional strength

H. Roughed in — Placing parts of utility systems inside a building skeleton before it is enclosed

I. Studs — The vertical members of a wall framing

II. Major parts of foundations

FIGURE 1



INFORMATION SHEET

A. Load bearing surface — The earth or bearing member upon which the footing rests

Example: Soil or bedrock

(NOTE: The load bearing surface may be far below the surface of a swamp, river, or sea.)

B. Footing — The flat part of the foundation that spreads the load of the structure above it.

C. Foundation walls — Walls or columns that rise above the footings.

(NOTE: These may be made of concrete, brick, block, or stone.)

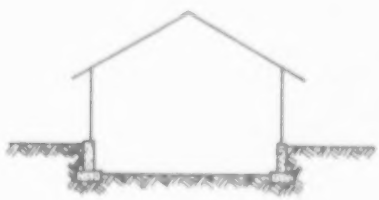
III. Types of foundations

(NOTE: Structures in different types of soil require different foundations. Sandy or wet soils give poor bearing surfaces, and bedrock and hard clay give strong bearing surfaces.)

A. Spread foundations — Used on load bearing surfaces of rock or hard soil

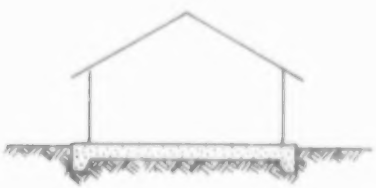
(NOTE: Spread foundations are like pads. They may be long and narrow. Under piers or posts, they may be square.)

FIGURE 2



B. Slab foundations (often called floating foundations) — Used over difficult terrain and/or soft ground and usually used for small buildings.

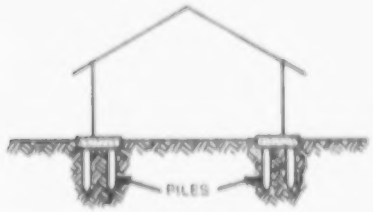
FIGURE 3



INFORMATION SHEET

C. Pile foundations — Used when soil will not support structure without driving a pile to lower level and solid bearing material.

FIGURE 4



IV. Materials used for foundations

A. Concrete — Most common material used because of its strength and ability to support heavy loads.

B. Crushed rock or gravel — Used in the construction of highways or runways; commonly used below other materials as a base and for drainage.

C. Natural materials — Wood or stone may be used for piers, piles, or foundation walls.

D. Steel — Used in the form of bars (rebars) and wire mesh to reinforce the concrete or as piles

V. Steps in setting foundations

A. Complete earthwork.

(NOTE: On most sites, some earthwork is done. The bearing surface must support the footing. If it is hard and solid, no additional work is done. If it is not, the earth may be compacted to form a hard, firm surface for the footing.)

B. Place footings on load bearing surface.

(NOTE: The following procedure is for concrete footings.)

1. Set forms in place.
2. Place steel reinforcement in the forms as specified.
3. Mix concrete.

(NOTE: This may be done on site by a mixer operator or it may be moved by truck to the site.)

INFORMATION SHEET

4. Place concrete in formwork.

5. Compact and finish concrete inside the forms.

6. Allow concrete to cure. Laborers then remove the formwork.

C. Place or build foundation walls for spread footings.

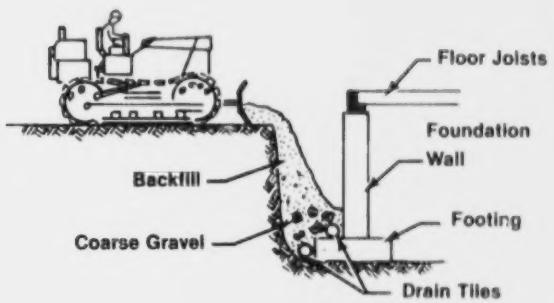
(NOTE: This procedure would be similar to pouring the footings using different forms. [Transparency 1] Concrete blocks and mortar may be used instead.)

D. Provide for permanent drainage using drain tiles and/or gravel placed next to footing and foundation wall.

(NOTE: This is especially important in areas with high water tables.)

E. Add backfill. After concrete has cured completely, earth is put back against the foundation.

FIGURE 5



VI. Types of frames for superstructures

A. Steel frames — Usually erected on site, piece by piece. Structural steel is used. It is made in a shop and sized to specifications according to an engineer's design drawings. Assembling structural steel is often subcontracted to a structural steel erector.

B. Concrete frames — Usually built on site; however, some parts may be manufactured and set into place.

C. Wood frames — Usually used for small structures such as houses. Wood frames consist of three major parts: floor framing, wall framing, and roof framing.

INFORMATION SHEET

VII. Structural steel shapes used for frame construction

A. I beam

B. Wide flange (WF) beam

C. Tee

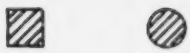
D. Channel

E. Angle

INFORMATION SHEET

F. Plate

G. Bars



Square Round

VIII. Steps in constructing steel frames

A. Lift steel pieces into place.

(NOTE: A crane is used to set each piece in place. Riggers attach the pieces to the lifting cables.)

B. Fasten steel pieces temporarily using bolts, rivets, or welds.

C. Plumb and brace the steel frame with guy wires.

D. Fasten permanently.

IX. Steps in constructing concrete frames

A. Concrete frames are constructed using columns, beams, slabs, and precast shapes.

(NOTE: The concrete used for frames construction is similar to that used for foundations. The difference is that the concrete for frames is stronger. To strengthen concrete, more cement is added to the mixture. The proportion of cement to aggregate is increased.)

B. Concrete frames are made using the following steps:

(NOTE: These steps are similar to those outlined in foundations.)

1. Build forms.
2. Set reinforcement.
3. Place concrete.

INFORMATION SHEET

4. Cure concrete.

5. Remove forms.

(NOTE: Precast concrete shapes may also be used. These are cast in a manufacturing plant and transported to site. They can save construction time.)

C. Concrete members are fastened or anchored together using dowels (reinforcing steel), trussed bar, and other methods.

X. Major steps in constructing wood frames

A. Layout and mark locations and positions of framing members according to working drawings.

B. Mark off the lengths of lumber.

C. Saw the lumber.

D. Assemble the parts.

E. Level and plumb the frame.

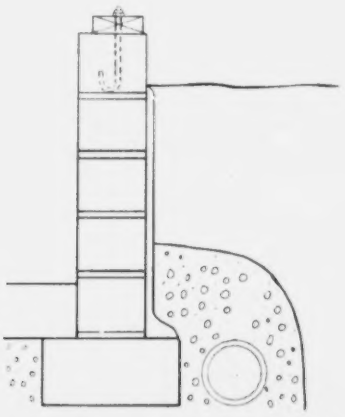
XI. Steps in erecting a structure (Transparency 2)

A. Set sills.

1. Anchor bolts are set in the foundation at the time the concrete is poured.

2. The sill is placed over the anchor bolts and secured to the foundation by nuts.

FIGURE 6



(NOTE: In some areas termites are a problem. In these areas a metal termite shield is placed on the foundation before the sill is attached.)

INFORMATION SHEET

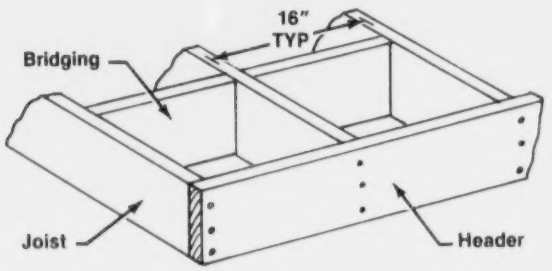
B. Assemble joists.

1. Joists are boards set on edge and extend between opposite foundation walls. They are generally set sixteen inches on center (16" OC).

2. Joists are usually 2 x 6s, 2 x 8s, 2 x 10s, or 2 x 12s and are held together by a header (same dimension of the joist).

3. Joists rest on the sill and provide support for the floor.

FIGURE 7

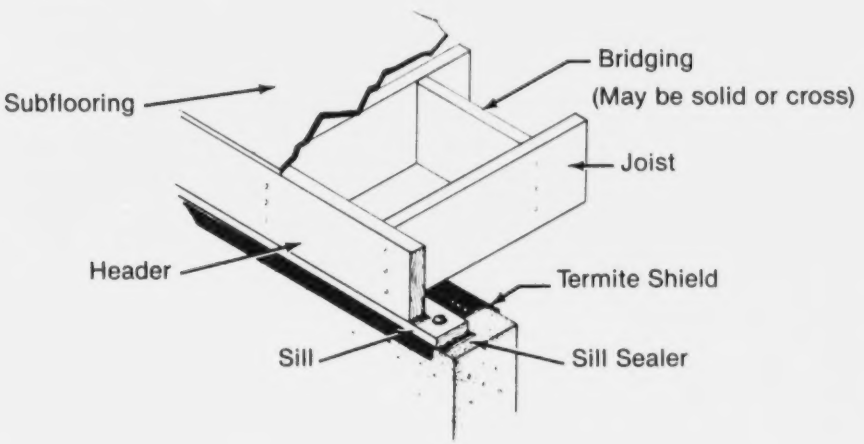


(NOTE: Bridging or blocking is used to hold the centers of the joist firm. It keeps the joists from bending or twisting as well as helps distribute a heavy load.)

C. Lay subflooring (rough flooring) on top of the joists and nail down.

(NOTE: Boards or sheet material may be used for subflooring. If boards are used, they are laid across the joists on a diagonal. Sheet materials are laid at right angles to the joists.)

FIGURE 8



INFORMATION SHEET

D. Assemble wall frames. (Transparencies 3 and 4)

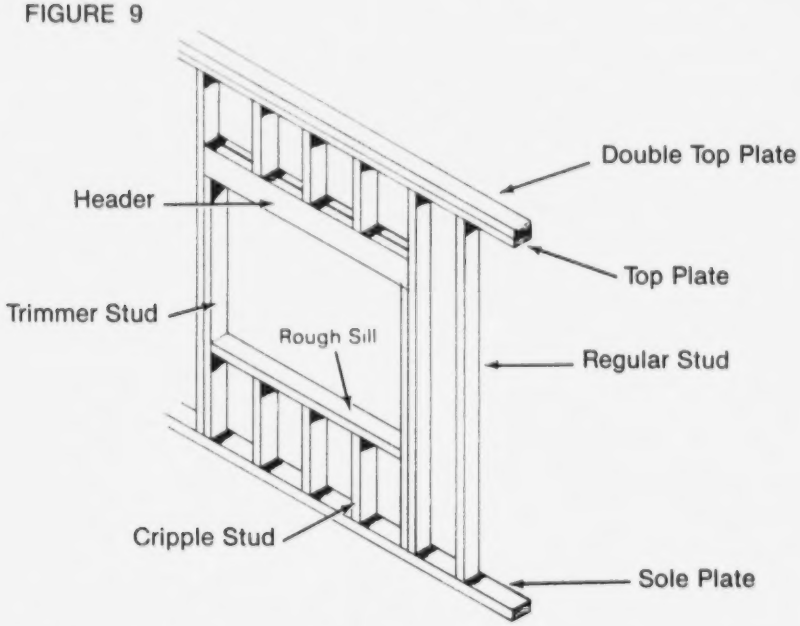
1. Exterior walls are put up directly on top of the outside foundation walls.

2. Interior walls are usually put up over inside foundation walls or girders.

3. Parts of a wall frame include studs, soleplate, and top plates.

   (NOTE: Bracing will normally be used for long, uninterrupted wall frames. Other parts such as headers, sills, and jambs are used for framing doors and windows.)

   FIGURE 9



   (NOTE: Walls for additional stories would be constructed at this time. Joists and headers are placed on the top plate of the first floor. They are covered with subflooring and walls are constructed on top of this. This is a method called platform framing.)

E. Assemble the roof frame.

1. Most wood framed buildings have sloped roofs.

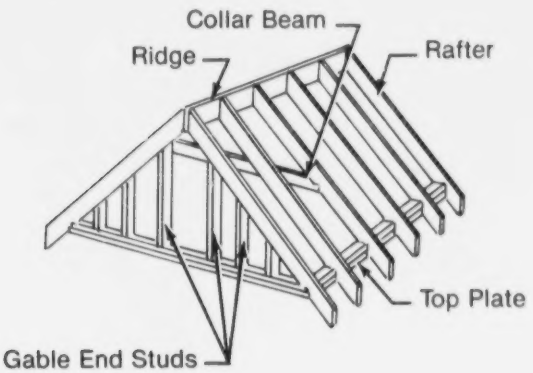
2. The top of the roof's slope is called the ridge. The bottom of the slope is called the eave.

INFORMATION SHEET

3. The roof is framed using rafters.

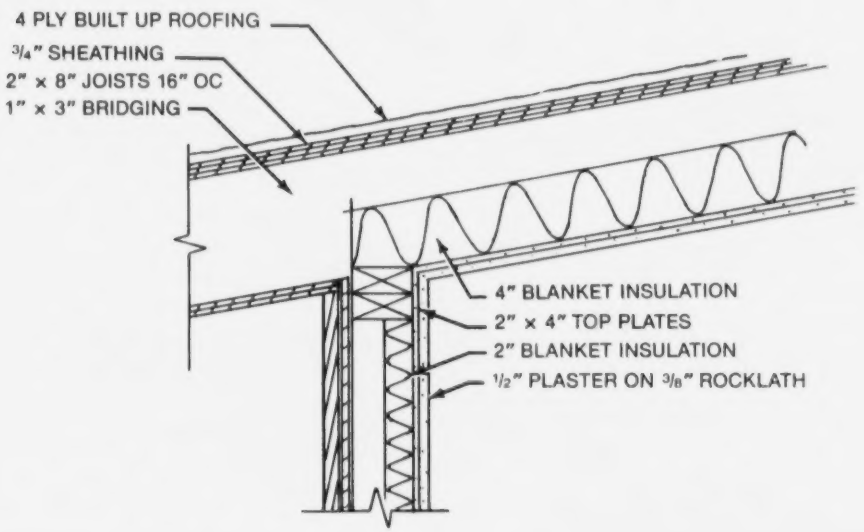
   (NOTE: The exact parts included will depend on whether a hip, shed, gable, or flat roof is used.)

   FIGURE 10



F. Install roof decking — Roof decking may be boards or sheet material and is nailed over the roof framing.

   FIGURE 11


4 PLY BUILT UP ROOFING
3/4" SHEATHING
2" x 8" JOISTS 16" OC
1" x 3" BRIDGING
4" BLANKET INSULATION
2" x 4" TOP PLATES
2" BLANKET INSULATION
1/2" PLASTER ON 3/8" ROCKLATH

INFORMATION SHEET

XII. Outside utility systems

A. Water

B. Sewage disposal

C. Gas

D. Electricity

E. Telephone service

F. Cable service

(NOTE: Almost all construction work requires utilities. Residential construction needs almost all of the mentioned utility systems, whereas other types of construction may only require a few of these.)

XIII. Inside utility systems

A. Climate control systems — Provide clean, conditioned air to make buildings comfortable.

1. Heating — Most commonly used method is direct heating. Fuel or solar energy heats the air itself. The air travels through the building in a system of ducts.

2. Cooling — Centrally located units or electric window units may be used. Both types remove heat from structures.

   (NOTE: Central air-conditioning units may use gas or electricity. Some of the electric units also provide heating. These are called heat pumps or reverse-cycle units.)

3. Dehumidifying and humidifying — These systems are used to add or take water out of the air for a more pleasant level of humidity.

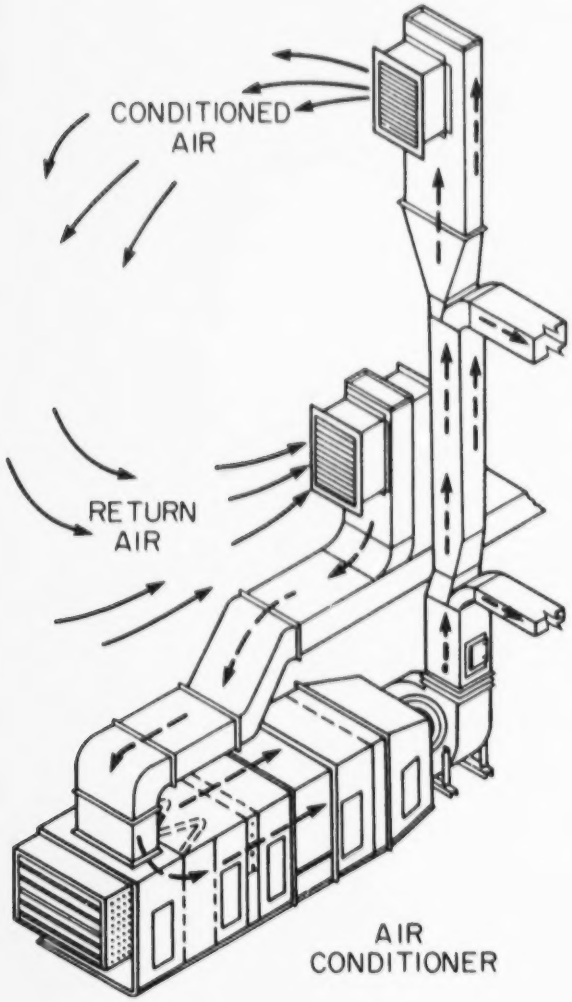
4. Filtering — A way of purifying the air. Some filters are permanent and are cleaned by electronic or sound devices, others are disposable and must be thrown away and new filters installed.

INFORMATION SHEET

5. Air return systems — Used air is exhausted through return air registers. These open into a second set of ducts. A slight vacuum created by fans pulls air through the return air ducts.

   (NOTE: This air may be exhausted to the outside or reconditioned and returned to the room.)

FIGURE 12



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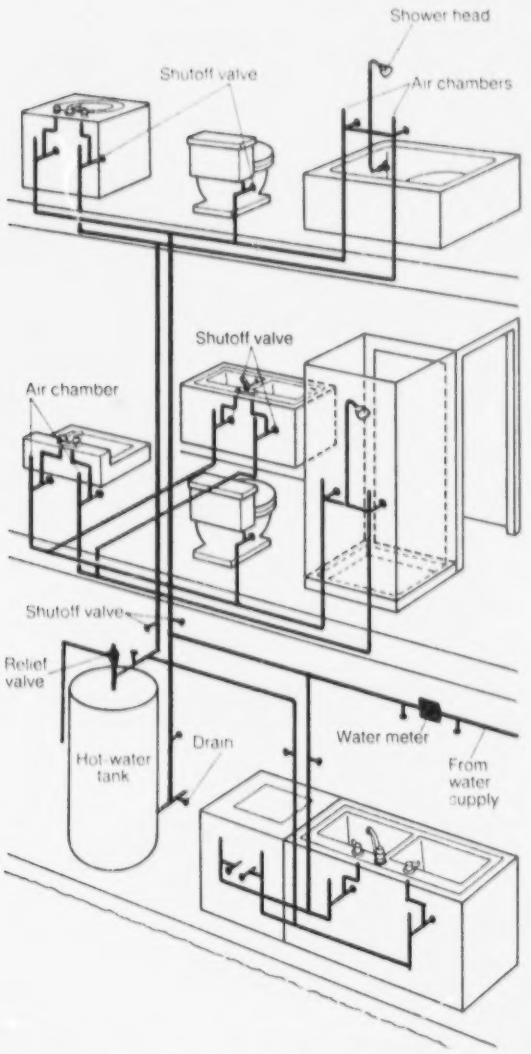
INFORMATION SHEET

B. Plumbing systems — Distribute liquids and gases throughout the building. They are made up of pipes and fittings of various sizes and materials.

1. Fresh water supply

FIGURE 13

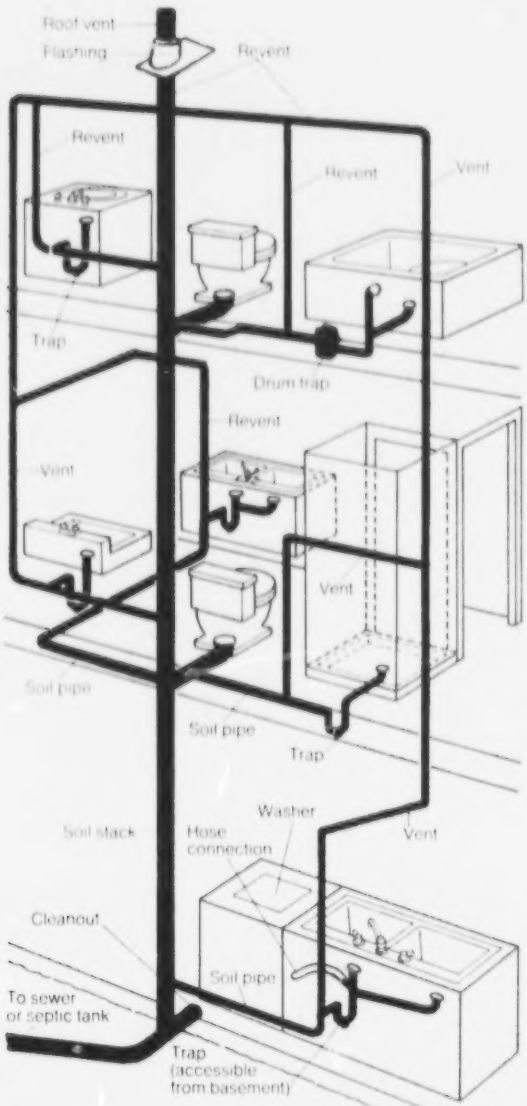


Illustrations courtesy of Reader's Digest Association, Inc. from the *Complete Do-It-Yourself Manual.*

INFORMATION SHEET

2. Drain-waste-vent system

FIGURE 14



Illustrations courtesy of Reader's Digest Association, Inc. from the *Complete Do-It-Yourself Manual.*

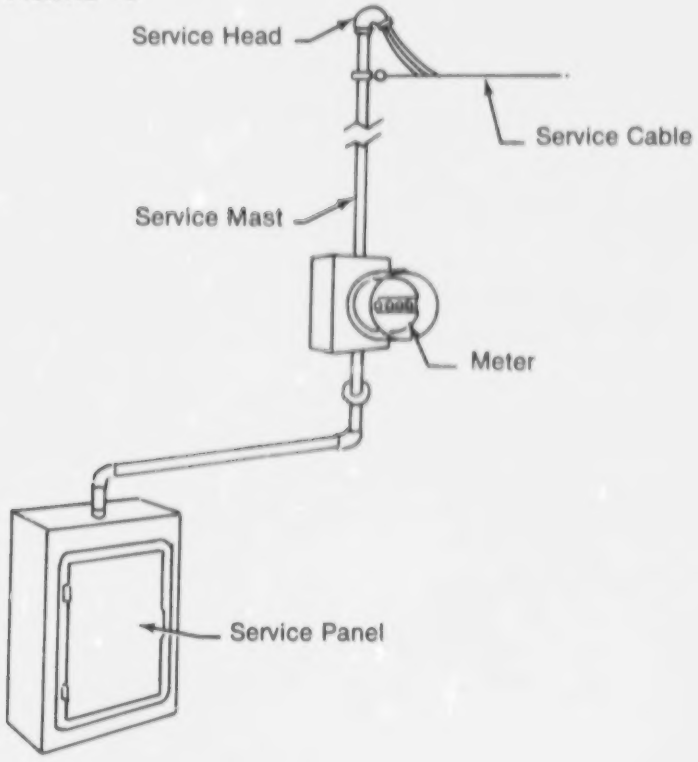
INFORMATION SHEET

C. Electrical systems

1. Power systems — For supp[illegible]lectrical power

a. Service structure — Electrical power enters a structure at a service entrance.

FIGURE 15



b. Branch circuits then run from the service panel.

(NOTE: Lights and electrical outlets are protected by a circuit breaker that is "tripped" when the demand is too great on any circuit.)

2. Communication systems for moving or processing information

a. Signs — Used mainly in public buildings

Example: Exit sign

INFORMATION SHEET

b. Bells

Examples: Door bells, alarms

c. Intercoms — Used to communicate over a small area

d. Televisions — Used for monitoring machines and processes for control and buildings for security

e. Telephones — Used in almost every structure

f. Computers — Used to process and store information and for monitoring controls.

g. Smoke detectors — Used as safety devices to alert occupants of a possible fire.

XIV. Sequence for roughing in the inside utility systems

(NOTE: Public utility lines are just outside property lines. They must be brought into a building to provide service.)

A. Ducts (used to carry fresh, warm, or cool air)

B. Pipes (used to carry water, waste, gas, or other material)

C. Electrical wires (used to distribute electrical energy)

(NOTE: Once the utilities are roughed in, the interior surfaces are enclosed. Then fixtures, switches, and outlets are installed.)

XV. Reasons for insulating structures

A. To save money (by reducing heating and cooling bills)

B. To increase comfort (by maintaining uniform temperatures and reducing noise)

C. To conserve energy (by reducing the demand on the nation's energy supplies)

INFORMATION SHEET

XVI. Types of insulation and methods for adding them

Type	*Method*
Rigid board	Nails or glue
Loose fill	Poured, blown, or sprayed
Batts or blankets	Staples, wire, or friction
Reflective	Nails or glue

XVII. Common areas to insulate

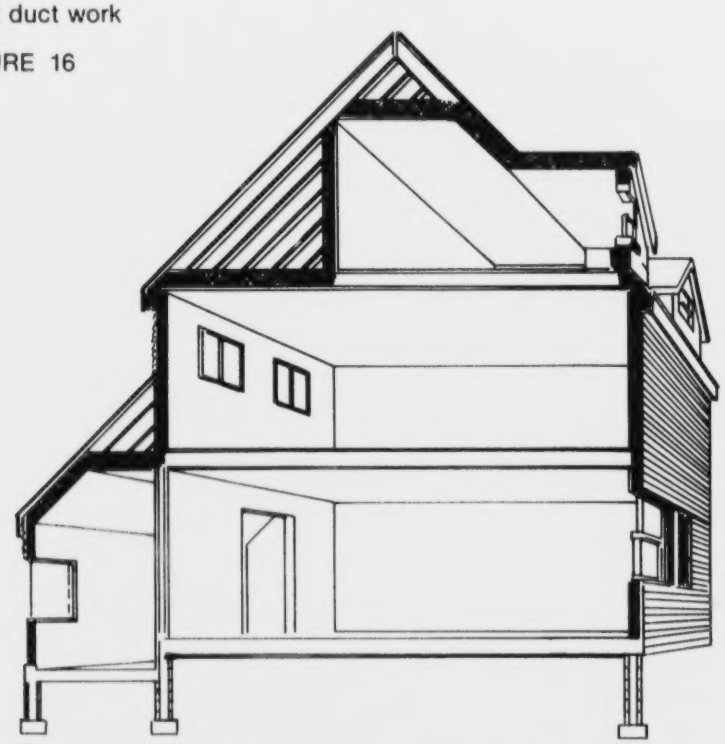
A. Walls, ceilings, and floors

B. Pipes and junction boxes on outside wall

C. Pipes carrying hot or chilled liquids

D. Most duct work

FIGURE 16



(NOTE: Vapor barriers are commonly added with insulation to keep moisture from condensing on insulation and from ruining wood and paint. A vapor barrier may already be attached to the insulation or may be a plastic sheet or liquid to be painted on.)

INFORMATION SHEET

XVIII. Enclosing the exterior

(NOTE: Builders enclose structures as soon as they can. Then, rain will not stop work. Damage is avoided when wood frames are kept dry.)

A. Enclosing the roof

1. Deck

   a. Forms a connecting bridge across the framing members as well as supports the roofing material.

   b. Materials used for residential decks are usually boards, plywood, fiberboard, or engineered board.

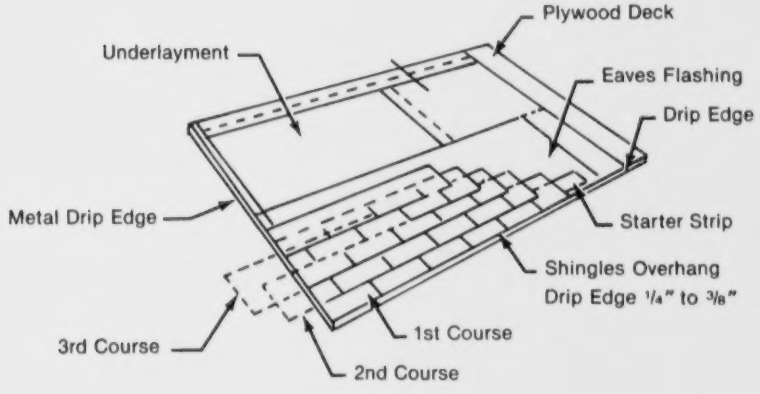
      (NOTE: Insulation can be added to a roof deck.)

2. Roofing

   a. Protects the building from rain and snow.

   b. Shingles or sheet roofing are commonly used on pitched roofs over an underlayment of roof felt.

      FIGURE 17



(NOTE: The edges of the deck are protected with a drip edge. The shingles overlap so water cannot get in the structure.)

3. Flashing — Used to stop leakage where the roof section joins another surface.

   Examples: In valleys, around pipes or chimneys

INFORMATION SHEET

B. Enclosing the wall

1. Doors and windows are used to provide for light and access for people to enter and leave structure.

2. Outside walls are covered in many kinds of materials such as wood, glass, stone, brick, plastic, concrete, and metal.

XIX. Enclosing the interior

(NOTE: Ceiling, wall, and floor coverings are needed for appearance, sound insulation, and some heat insulation. These coverings hide the framing, pipes, ducts, wires, and insulation. Enclosing the inside includes doing rough work and finish work.)

A. Walls — Most walls are covered by paneling or gypsum board (drywall). These products are sold in sheets and are nailed to the wall studs.

1. Once nailed up, paneled walls are finished except for finishing trimwork (such as baseboards).

2. Gypsum boards are taped at the seams and rough spots are finished with joint compound. They can then either be painted or wallpapered.

(NOTE: Enclosing masonry walls requires furring strips before applying drywall or other wall materials. These strips provide space for insulation and a nailing space for paneling or drywall.)

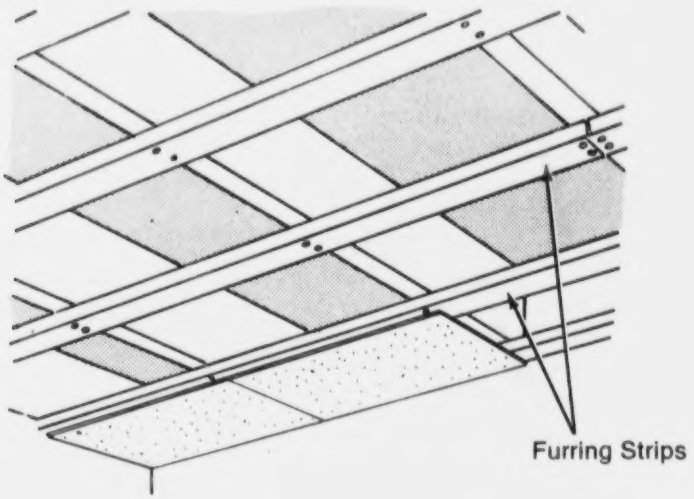
B. Ceilings — Some ceilings are the underside of a roof while others have their own framing wall below the roof structure. There are three major types of ceilings.

1. Gypsum-board ceiling — Installed before the walls using the same materials and methods

INFORMATION SHEET

2. Ceiling tiles — Small pieces of ceiling material may be applied with mastic, staples, or nails to furring strips.

FIGURE 18



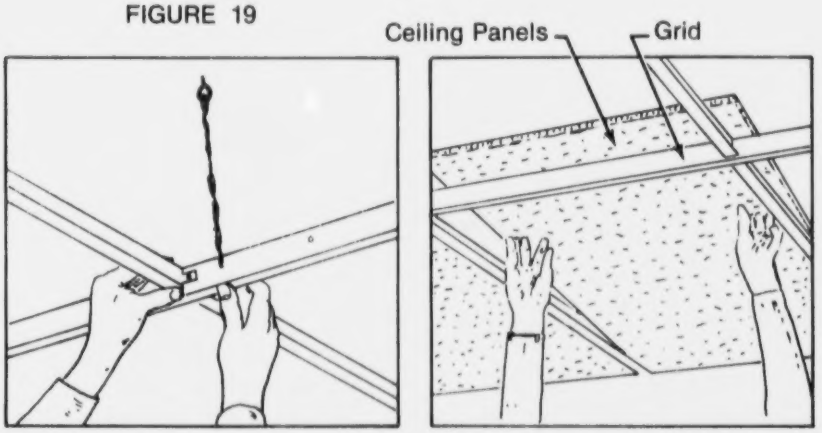
3. Suspended ceilings — Are commonly used when pipes, electrical wiring, or heating ducts need to be covered or when the ceiling height needs to be lowered.

   a. Wire hangers are attached to the framing above. A grid system is fastened to the wires.

   b. Ceiling panels are then placed in the grid.

   (NOTE: Ceiling systems may have lights and air ducts included.)

FIGURE 19



INFORMATION SHEET

C. Subfloors — Are installed early to provide weight-bearing strength as well as a place to store materials and a space to work.

1. Plywood subfloors — Are covered with underlayment to provide a smooth surface for floor covering. Smooth plywood, particle board, and hardboard are commonly used materials for the underlayment.

2. Concrete floors — A layer of special concrete is placed over a freshly poured slab. It is then troweled smooth. This finish provides a smooth, sanitary, and long wearing floor.

XX. Finishing the project

(NOTE: Architects and building interior designers select the materials, fixtures, and equipment used to finish the project. Finish workers must take special care in their work because this work is easily seen.)

A. Finish work in a house is done when both outside and inside construction of structure is finished.

B. Finish work is done for appearance, protection, and usefulness.

C. Finish work includes trimming, painting, decorating, and installing.

1. Painting

a. Interior painting is often the first finish work to be done.

(NOTE: It is easier to paint before the trim is up and the outlet covers are on.)

b. Paint may be applied with brushes, rollers, or sprayers.

2. Decorating

a. Walls can be decorated with wall covering, paneling, boards, and tiles.

b. Floors can be finished with resilient flooring, wood, carpet, or masonry materials such as ceramic tile, stone, or terrazzo.

3. Trimming

a. Moldings and trim are used on the inside and outside of the structure to cover up cracks.

b. Caulking — Used inside and out to keep water out and to prevent air infiltration (energy savings).

(NOTE: Caulking is commonly used around windows, doors, and plumbing fixtures.)

INFORMATION SHEET

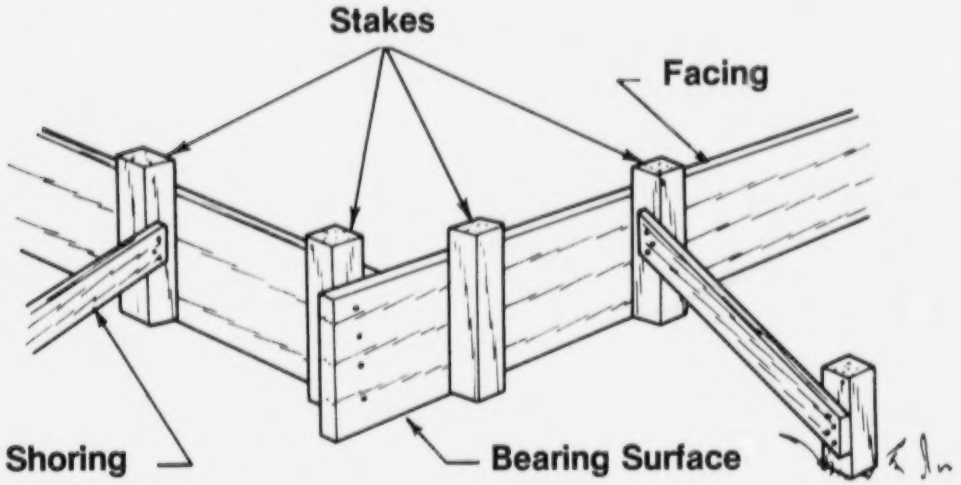
4. Installing

(NOTE: Oftentimes work must wait until equipment and fixture connections are ready.)

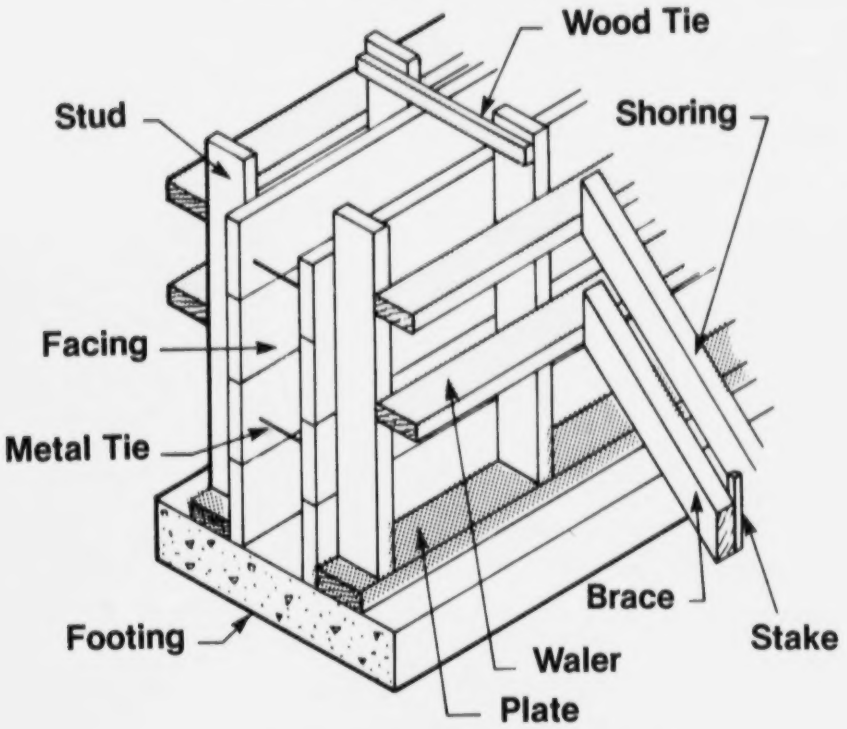
a. Equipment and fixtures are often installed throughout the construction project.

b. Most fixtures and appliances are installed after painting, decorating, and trimming is completed.

Foundation Forms



Slab Foundation



Foundation Wall

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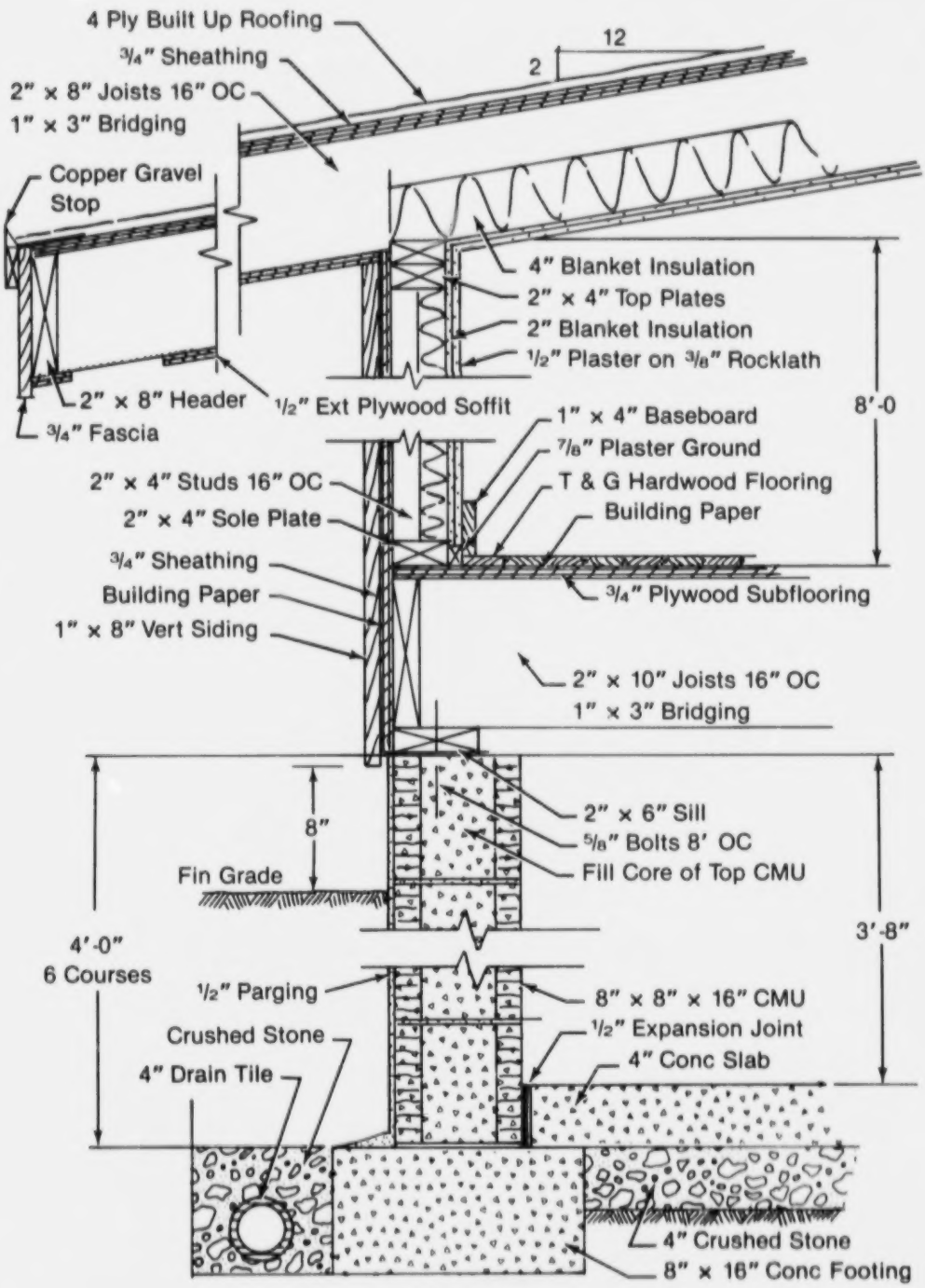
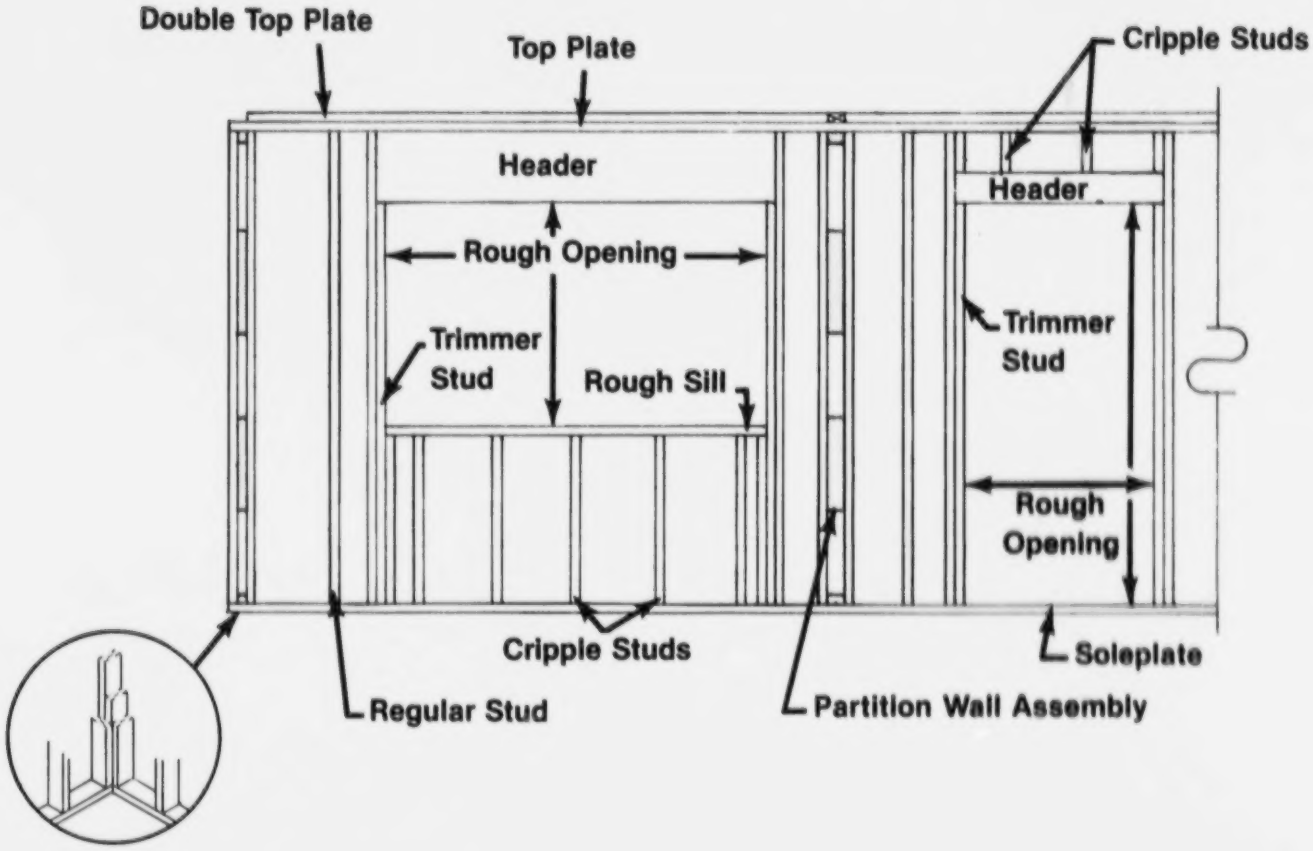
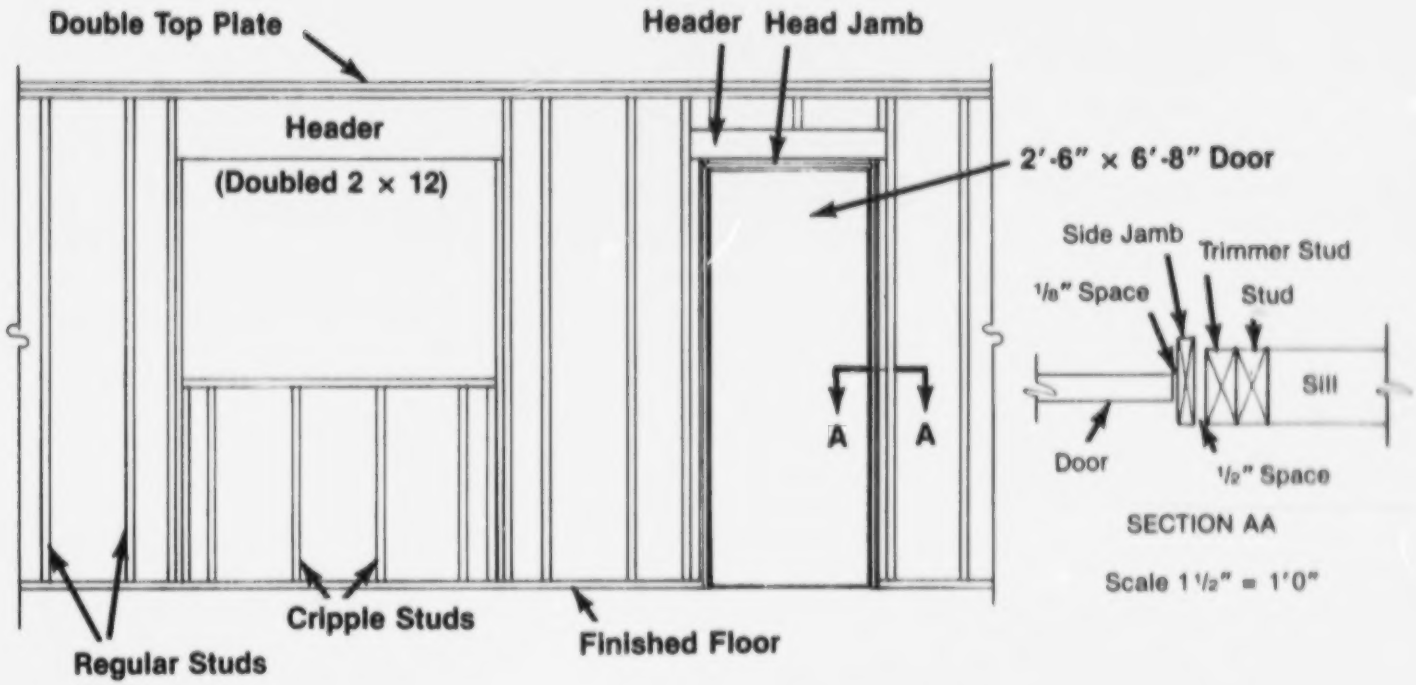
Cross Section of a Structure



Wall and Partition Framing Members



Door and Window Headers



Scale: 3/8" = 1'-0"

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #1 — POUR A CONCRETE FOUNDATION

A. Tools and materials

1. 1 - Pliers
2. 1 - Concrete mixing hoe
3. 1 - Old paint brush
4. 1 - Wheelbarrow (for mixing concrete)
5. 1 - Framing square
6. 1 - Can (3 qt. size)
7. 1 - Hammer
8. 1 - Screed (1½ in. × 3½ in. × 18 in.)
9. 1 - Float
10. 1 - Trowel
11. 1 - Hard hat per worker
12. 1 - Form material (1½ in. × 1½ in. × 7 ft.)
13. 1 - Form base (½ in. × 18 in. × 32 in.)
14. 2 - Form cleats (¾ in. × 1½ in. × 48 in.)
15. 2 - #3 Rebars (27 in. long)
16. 4 - #3 Rebars (11 in. long)
17. 1 - Asphalt felt (36 in. × 48 in.)
18. 1 - Tie wire (24 in. black annealed wire)
19. Supply - Used motor oil
20. 1 - Concrete mix (bag)
21. 1 - Plastic sheet (18 in. × 36 in.)

JOB SHEET #1

22. Supply - Double headed nails, 12d

23. Supply - Double headed nails, 8d

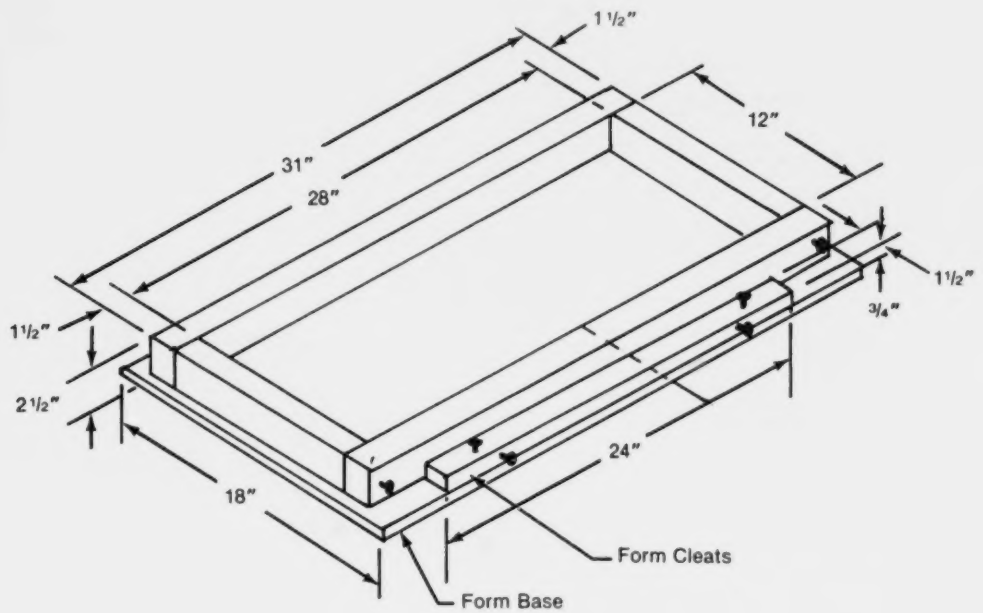
B. Procedure

(NOTE: This procedure is for a concrete stepping stone. Your instructor may provide instructions for a different foundation.)

1. Carpenters construct the form as shown in Figure 1.

2. Paint used oil on the inside of the form.

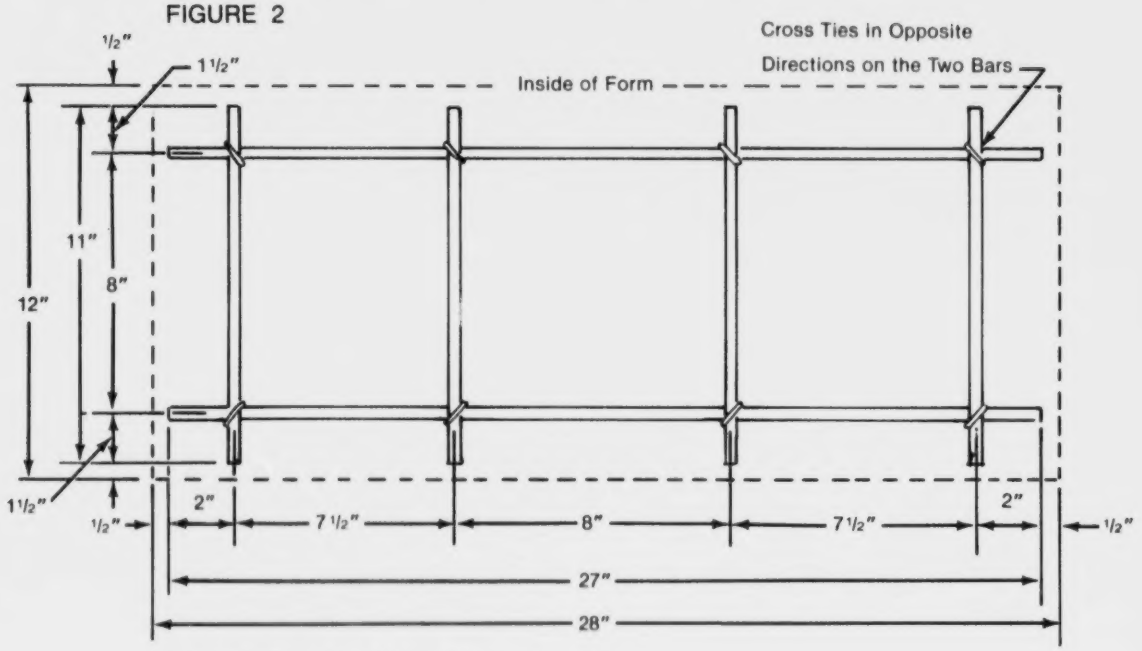
FIGURE 1



JOB SHEET #1

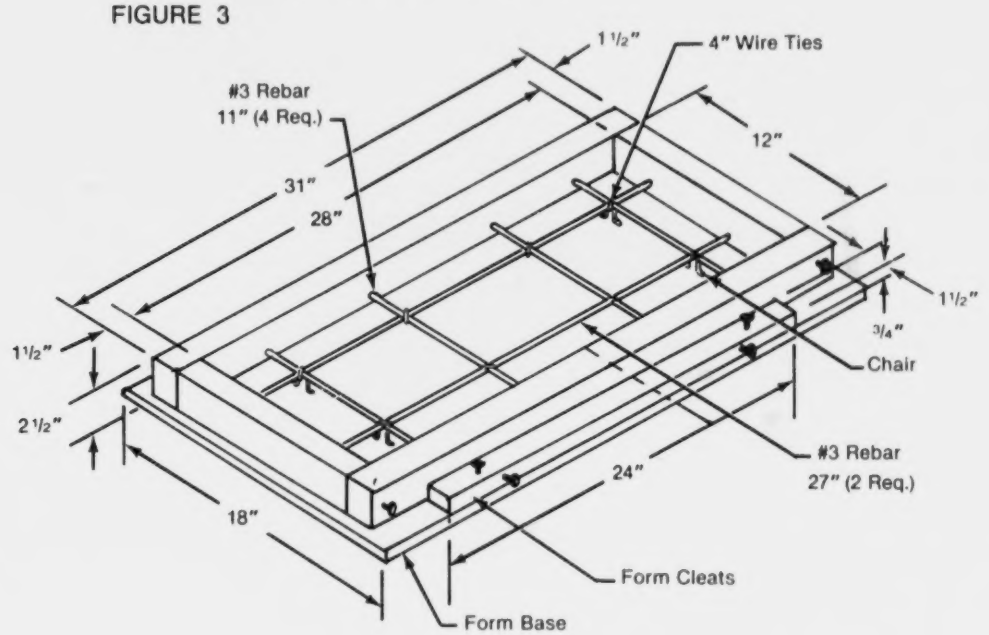
3. Steel setters tie and place the steel reinforcements.

FIGURE 2



(NOTE: Form should now look like this.)

FIGURE 3



JOB SHEET #1

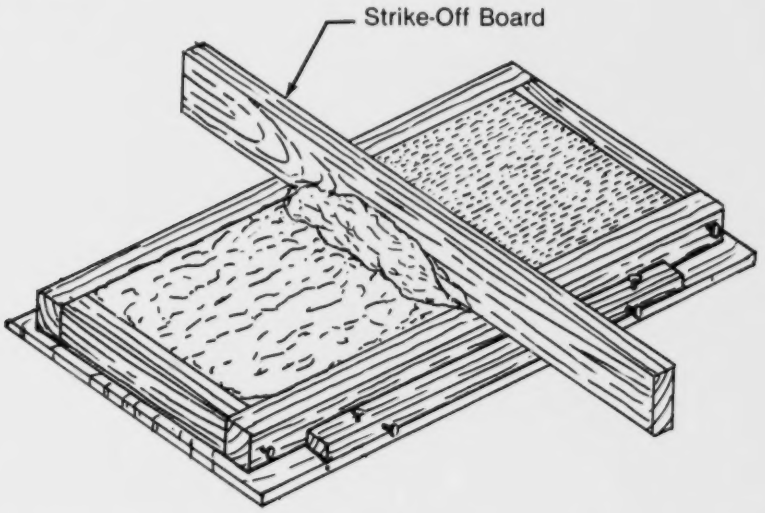
4. Concrete workers mix the concrete for the project. The coarse aggregate, sand, and cement are already thoroughly mixed and bagged. Just add the water. BE SURE TO FOLLOW INSTRUCTIONS ON THE BAG. Mix all ingredients thoroughly.

5. Gently place the concrete in the form. Work it around the steel.

6. Work the air out of the concrete by tapping the forms lightly with a hammer.

7. Screed the top until it is level. (Figure 4)

FIGURE 4



8. Finish the surface of the concrete using floats and trowels until smooth.

9. Cover it with plastic and allow it to cure (5-7 days).

10. Report to the job superintendent when you have finished.

(NOTE: You will strip forms in approximately five days.)

(CAUTION: Do not wash excess concrete down the drain. It will harden in the trap.)

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #2 — BUILD A WOOD FRAME STRUCTURE

A. Equipment and materials

(NOTE: This is equipment needed in each step. Additional materials will be listed as needed.)

1. Hammers
2. Framing squares
3. Carpenter's pencils
4. Saws
5. Tape measures
6. Hard hats
7. Safety glasses

B. Procedure

(NOTE: This job sheet is for a conventional frame structure. The walls use 2 x 4 studs placed on 16 in. centers. This allows 4 ft. wide panels to be nailed on the frame without being cut. Your instructor may supply dimensions.)

1. Construct a 2 x 4 wall frame building as follows:

   a. Identify a group leader to read the drawings and make work assignments.

   b. Collect the following materials for a 2 x 4 wall section.

1 - Top plate (2 in. x 4 in. x 48 in.)
2 - Plates (2 in. x 4 in. x 37 in.)
4 - Studs (2 in. x 4 in. x 67 1/2 in.)
2 - Cripples (2 in. x 4 in. x 64 in.)
2 - Headers (2 in. x 4 in. x 23 1/2 in.)
Space for header - Plywood (1/2 in. x 3 1/2 in. x 6 in.)
1 - Sheathing (1/2 in. x 48 in. x 79 1/2 in.)
Common nails, 12d
Common nails, 8d
Common nails, 6d

JOB SHEET #2

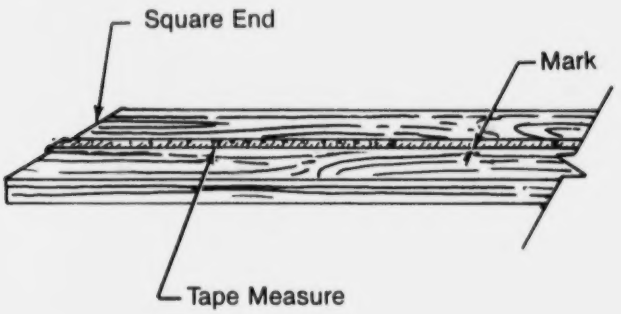
c. Assign different carpenters to lay out and saw different parts.

(NOTE: It may help to work in pairs.)

d. Remember the following when laying out and sawing lumber:

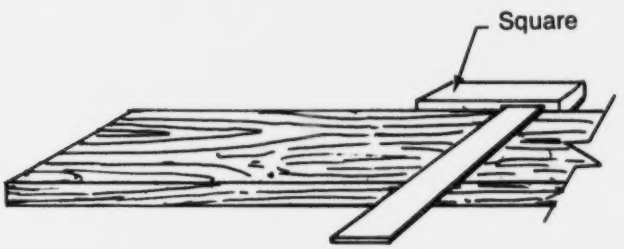
1) Measure from a squared edge.

FIGURE 1



2) Use a square to mark the length.

FIGURE 2



3) Saw on the waste side of the line.

(NOTE: You may be instructed to use power equipment. Follow safety rules that apply to the equipment you are using.)

e. When laying out the location of studs, remember to:

1) Measure from one end.

2) Draw lines for at least one edge of the stud on the sole plate (horizontal member above subfloor).

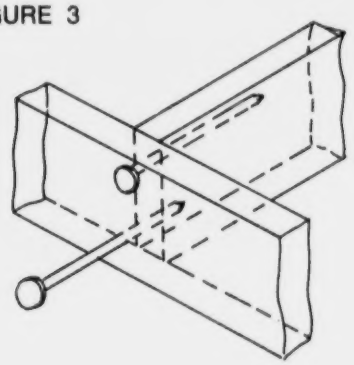
3) Use an X to show the location of the end face of the stud.

JOB SHEET #2

f. Nailing methods used will be:

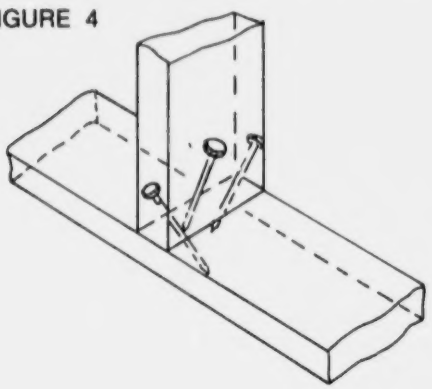
1) Face nailing — Nails are driven straight through the face of the board.

FIGURE 3



2) Toe nailing — Nails are driven at an angle to the face of the board.

FIGURE 4



g. Lay out and saw the parts used in the wall. Measure and saw carefully!

h. Lay out the locations of the studs on the top and bottom plates (mark each location with an X).

i. Refer to Figure 5 for the locations of the parts to be marked.

j. Facenail framing members together with 12d nails.

k. Facenail the header together with 8d nails.

l. Nail sheathing in place with 6d nails.

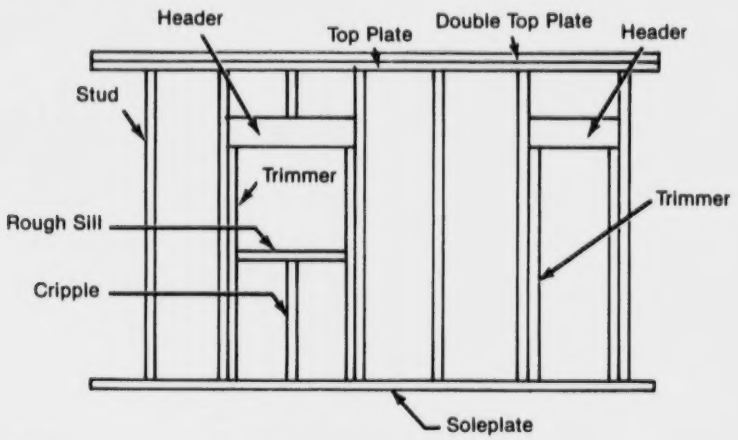
m. Report to the job superintendent when you have finished.

JOB SHEET #2

n. Clean up area.

(NOTE: Continue with construction of wall section placing doors or windows as directed by your instructor.)

FIGURE 5



2. Frame a floor.

(NOTE: This procedure is for the floor platform for the structure. Other crews will be building other parts of the structure.)

a. Identify a group leader to read the drawings and to make work assignments.

b. Collect the following equipment.

2 - Sill plates (2 in. × 6 in. × 48 in.)
2 - Sill plates (2 in. × 6 in. × 37 in.)
2 - Joist headers (2 in. × 6 in. × 48 in.)
3 - Joists (2 in. × 6 in. × 45 in.)
1 - Subfloor (½ in. × 48 in. × 48 in.)
Common nails, 12d
Common nails, 8d
Common nails, 6d

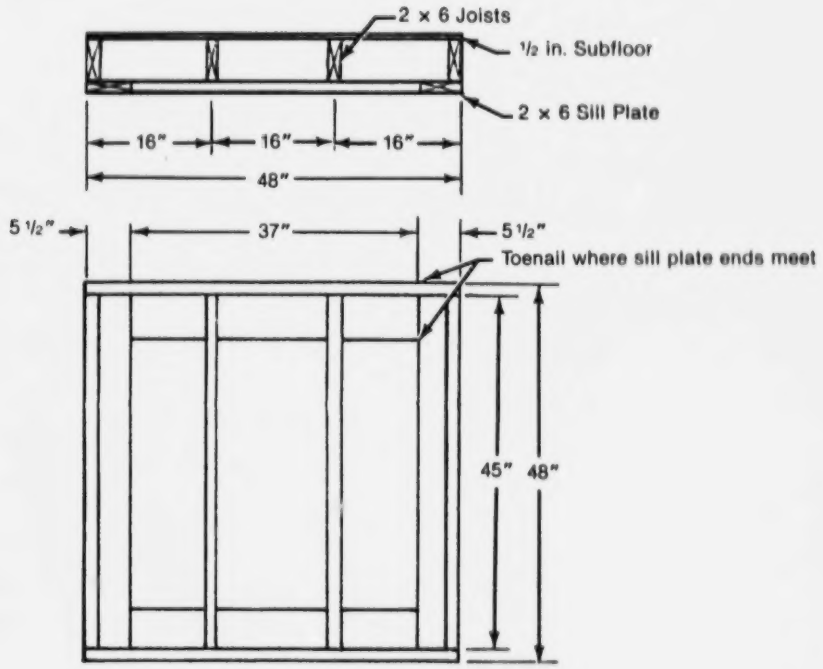
c. Assign different people to lay out and saw different parts.

(NOTE: It may help to work in pairs.)

The floor platform is shown.

JOB SHEET #2

FIGURE 6



d. Lay out and saw the sills, joist headers, subfloor, and joists. Measure and saw carefully!

e. Lay out placement of joists on the joist header.

f. Facenail the joist header to the joists with 12d nails.

g. Toenail the sills together with 12d nails.

h. Toenail floor joists together with 8d nails.

i. Facenail subfloor down with 6d nails.

j. Report to the job superintendent when finished.

(NOTE: Attach walls and floor as instructed.)

k. Clean up area.

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #3 — ROUGH IN COPPER WATER LINES

A. Equipment and materials

1. 1 - Pad of steel wool
2. 1 - Electric drill with 3/4 in. spade bit
3. 1 - Hammer
4. 1 - Tape measure
5. 1 - Screwdriver
6. 1 - Tubing cutter
7. 1 - Tubing reamer
8. 1 - Propane torch
9. 1 - Striker
10. 1 - Cement board or several fire bricks
11. 1 pr. - Safety glasses for each plumber
12. 1 - Hard hat for each plumber
13. 1 - Pipe nipple (1/2 in. × 3 in.)
14. 1 - Elbow (1/2 in. solder ends)
15. 1 - Copper tubing (1/2 in. × 15 in.)
16. 2 - Flat head wood screw (3/4 in. × 8)
17. 1 - 50-50 solid core solder (roll)
18. 1 - Rosin solder flux (can)
19. 1 - Backing board (3/4 in. × 5 1/2 in. × 14 1/2 in.)
20. 2 - Backing board blocks (3/4 in. × 3/4 in. × 8 in.)
21. 8 - Common nails, 8d
22. 1 - Knockdown corner section or construction project

JOB SHEET #3

B. Procedure

(NOTE: The same dimensions are used for both knockdown corner sections and the wood frame structure built in Job Sheet #2.)

1. Identify a student as plumbing supervisor to read the drawings and direct the work.

2. Divide the work among members of the group. Each worker or pair can:

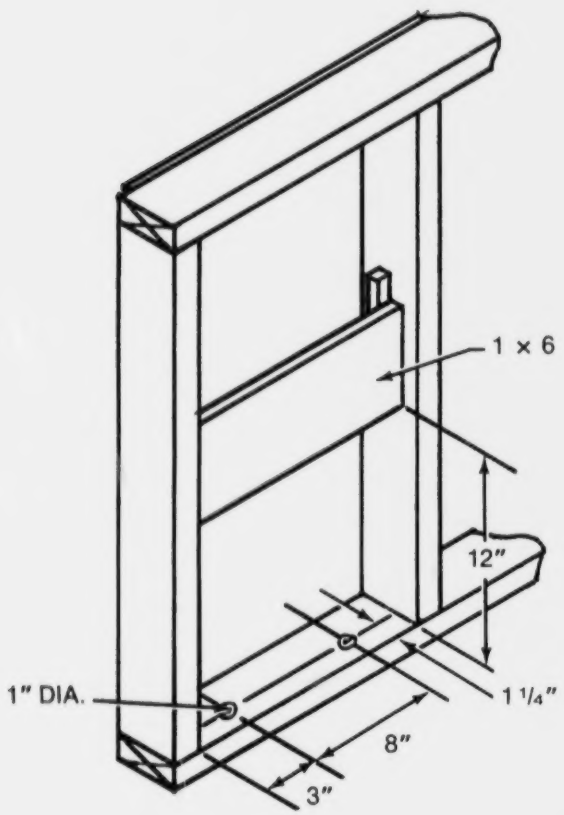
   a. Measure, saw, and nail on the backing board and blocks.

   b. Drill the hole through the bottom plate.

   c. Cut and assemble the tubing, elbow, and nipple.

   (CAUTION: Wear safety equipment and use fireproof materials when soldering.)

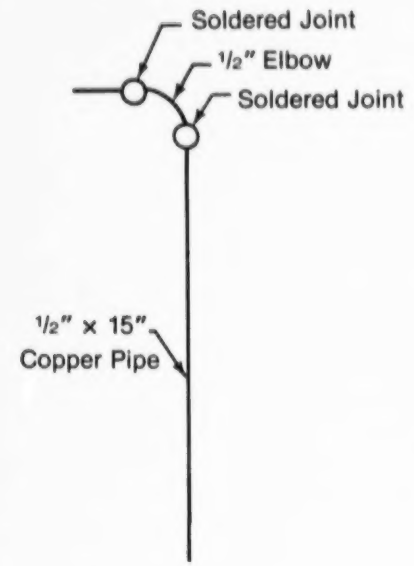
FIGURE 1



JOB SHEET #3

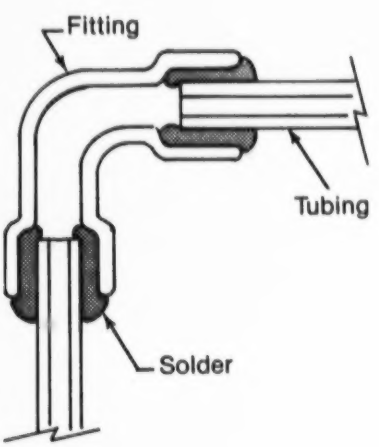
3. Install the pipe assembly.

FIGURE 2



(NOTE: A solder or sweat joint is made when the fittings and tubes are held together by solder.)

FIGURE 3



4. Report to the job superintendent when your crew is finished.
5. Clean up area.

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #4 — ROUGH IN PLASTIC WATER LINES

A. Materials and equipment

1. 1 - Tape measure
2. 1 - Screwdriver
3. 1 - Tubing cutter or hacksaw
4. 1 - Tube reamer
5. 1 - 10 in. adjustable end wrench
6. 1 pr. - Safety glasses for each plumber
7. 1 - Hard hat for each plumber
8. 1 - Elbow adapter (1/2 in.)
9. 1 - Nipple (1/2 in. × 3 in.)
10. 1 - Solvent cement

    (NOTE: Solvent system comes in two cans, a cleaning agent and a welding agent.)

11. 1 - CPVC pipe (1/2 in. × 15 in.)
12. 2 - Flathead wood screws (3/4 in. × 8)
13. 1 - Pipe dope (can) or Teflon tape
14. 1 - Knockdown corner section

B. Procedure

(NOTE: The same dimensions are used for the knockdown. This job sheet is for installing cold water lines.)

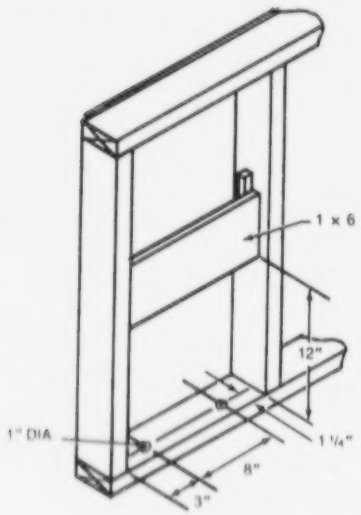
1. Identify a student as plumbing crew supervisor to read the drawings and to direct the work.
2. Divide the work among members of the group. Each worker or pair can:

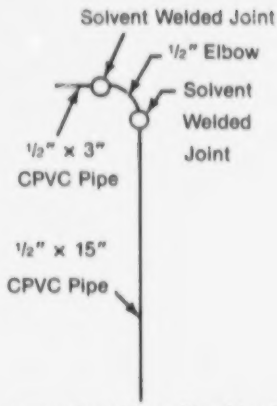
    a. Drill a hole through the bottom plate.

JOB SHEET #4

b. Cut and assemble the tubing, elbow, and nipple.

FIGURE 1





Plastic Cold Water Plumbing Plan

3. Install the pipe assembly.

   (NOTE: Follow manufacturer's directions for solvent cement use. Instructor may direct installing the pipe assembly without actually using cement. This will enable reuse of pipe by other students.)

4. Report to the job superintendent when your crew is finished.

5. Clean up area.

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #5 — ROUGH IN ELECTRICAL POWER SYSTEMS

A. Materials and equipment

1. 1 - Tape measure
2. 1 - Tubing cutter
3. 1 - 10 in. adjustable wrench
4. 1 - Screwdriver
5. 1 - Fish tape and reel
6. 1 - Wire stripper
7. 1 - Needlenose pliers
8. 1 - Hard hat for each electrician
9. 1 pr. - Safety glasses for each electrician
10. 2 - Electrical boxes (single)
11. 1 - Octagonal box
12. 1 - Adjustable joist hanger
13. 4 - Cable connectors (1/2 in.)
14. 2 - Wire nuts (3 - 12 ga. wires)
15. 1 - EMT conduit (3/4 in. x 24 in.)
16. 1 - EMT conduit (1/2 in. x 30 in.)
17. 2 - EMT box connectors (1/2 in.)
18. 1 - Hammer
19. 1 - Electric drill
20. 1 - 5/8 in. spade bit
21. 1 - 1 in. spade bit

JOB SHEET #5

22. 1 - Entrance ell (3/4 in.)
23. 1 - EMT box connector (3/4 in.)
24. 1 - Insulated copper wire (12 ga. × 48 in. white)
25. 1 - Insulated copper wire (12 ga. × 48 in. black)
26. 2 - Ground wire bushings
27. 1 - Ground wire clip
28. 1 - Nonmetallic cable (12/2 with ground, measure and cut to length)
29. 1 - Metallic cable (12/2 with ground × 24 in.)
30. 1 - Fuse box
31. Braided wire (16/3 × 48 in.)
32. Insulated staples

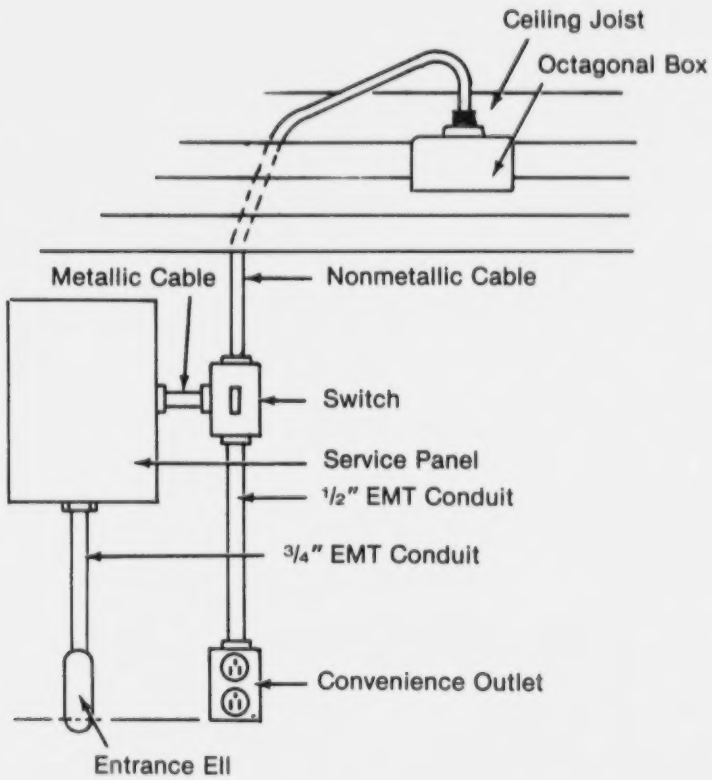
B. Procedure

(NOTE: This circuit may be installed in either the wood frame structure or the knock-down corner section.)

- Safety glasses should be worn at all times.
- Power source should not be activated until instructor is ready and the wiring procedure has been checked.

JOB SHEET #5

FIGURE 1 — Mounting position pictorial view



JOB SHEET #5

1. Attach boxes to structure or knockdown section. (Figure 2)

   FIGURE 2

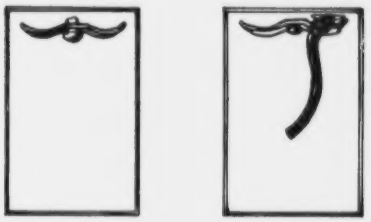
2. Measure cable and cut to proper length.

   (NOTE: Leave approximately 8" on each end sticking through the boxes.)

3. Remove plugs from each box so cable can be installed.

4. Loosen screw in boxes on holddowns and install cables. (Figure 3)

   FIGURE 3



5. Tighten screws and holddowns.

6. Remove 6" of outer insulation from the cable using the stripper or knife.

   (NOTE: Use cutting device carefully.)

7. Remove 1/2" to 3/4" of insulation from the end of each wire.

   (CAUTION: Do not scratch or knick the wire when removing insulation.)

8. Connect single pole switch to wire.

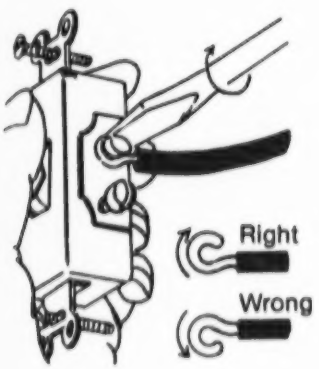
   (NOTE: Connect the white wire to the brass screw and black wire to the silver screw. This is the only time a white wire will be connected to the brass screw and black wire connected to the silver screw. The black wire is referred to as the traveler wire on the switch leg.)

JOB SHEET #5

9. Place wires on terminals as shown in Figure 4.

   (NOTE: To attach wire to a screw terminal after stripping the wire, bend a hook in its end with long-nose pliers, hook end around screw, and tighten. Attached wire should hook clockwise around screw as shown.)

   FIGURE 4

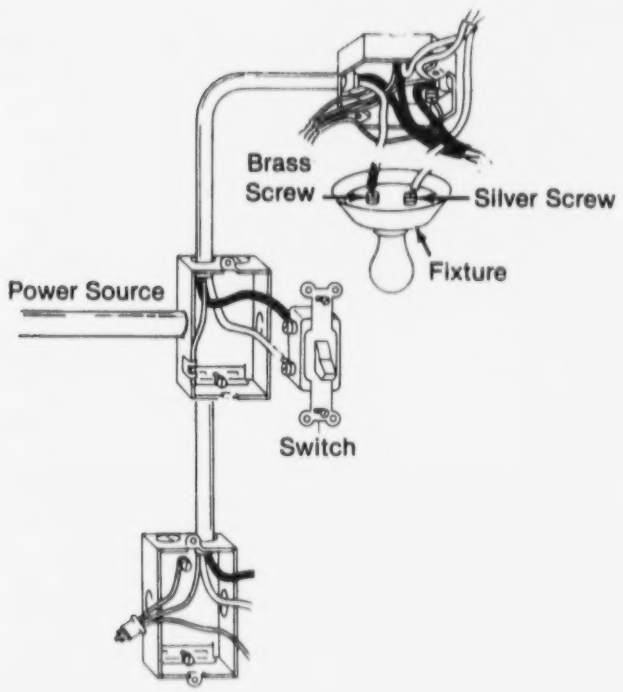


10. Connect the black wire to brass screw in lighting outlet.

JOB SHEET #5

11. Connect the white wire from switch to black wire from source. (Figure 5)

FIGURE 5

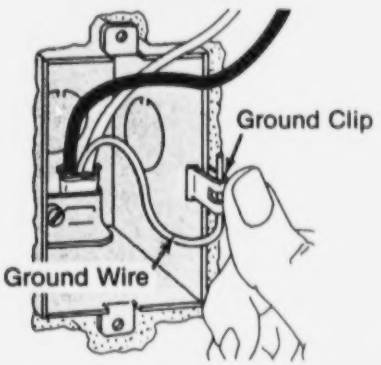


JOB SHEET #5

12. Attach ground wire to box with clip as shown. (Figure 6)

    (NOTE: Connect ground wire to metal box by using the ground screw in back of the box or a ground clip as shown here. Insert the ground wire under the clip and force clip onto the rim of the box.)

    FIGURE 6



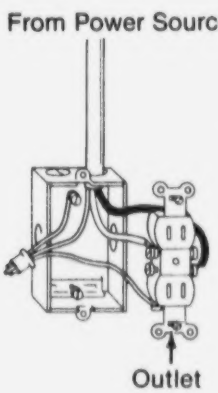
13. Install duplex receptacle.

14. Connect black wire to brass screw on receptacle.

15. Connect white wire to silver screw on receptacle.

16. Connect the black wire from the receptacle to the connection of black wire from the source in the octagon box. (Figure 7)

    FIGURE 7



JOB SHEET #5

17. Attach ground wire nut to ground wires.

(NOTE: To join wires with a connecting nut, insert the wire ends into the nut and tighten clockwise. Some nut manufacturers specify that the wire ends first be twisted with pliers as shown.)

FIGURE 8

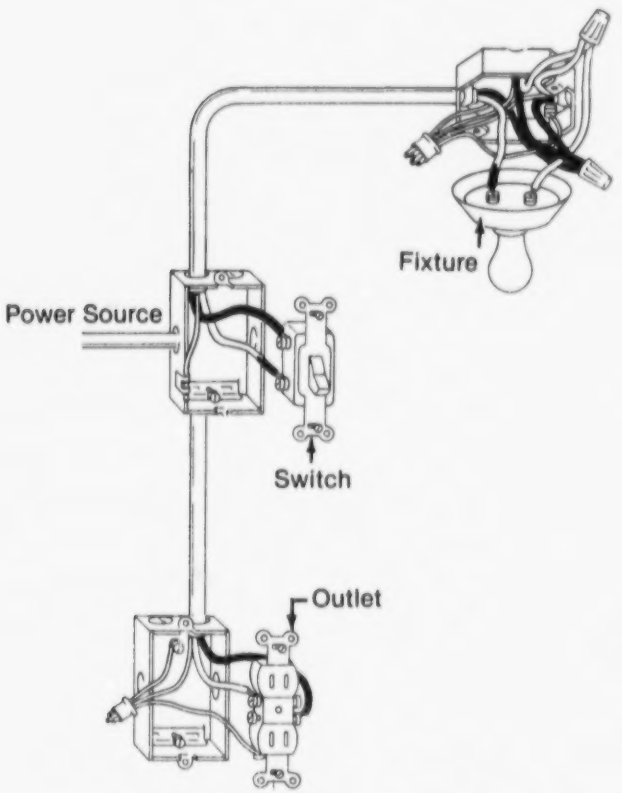
18. Cut a short pigtail wire (white) and connect to silver screw on lighting outlet.

JOB SHEET #5

19. Connect white wire from source, white wire from receptacle, and white pigtail from lighting outlet with a wire nut inside the octagon box. (Figure 9)

    (NOTE: Make sure no bare wire is showing.)

    FIGURE 9



Illustrations courtesy of Reader's Digest Association, Inc. from the *Complete Do-It-Yourself Manual.*

20. Connect ground wire bushing to ground wires.

    (NOTE: Figure 9 is a diagram of the finished product. Plan to have instructor evaluate wiring procedure. Then the instructor will connect the power source.)

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #6 — LAYOUT AND CONSTRUCT A ROOF TRUSS

A. Materials and equipment

Each work crew will need the following:

1. 2 - Claw hammers
2. 2 - Crosscut saws
3. 2 - Steel tapes (12')
4. 1 - Try square
5. 1 - Framing square
6. Nail aprons
7. Pencils

The instructor will supply the following:

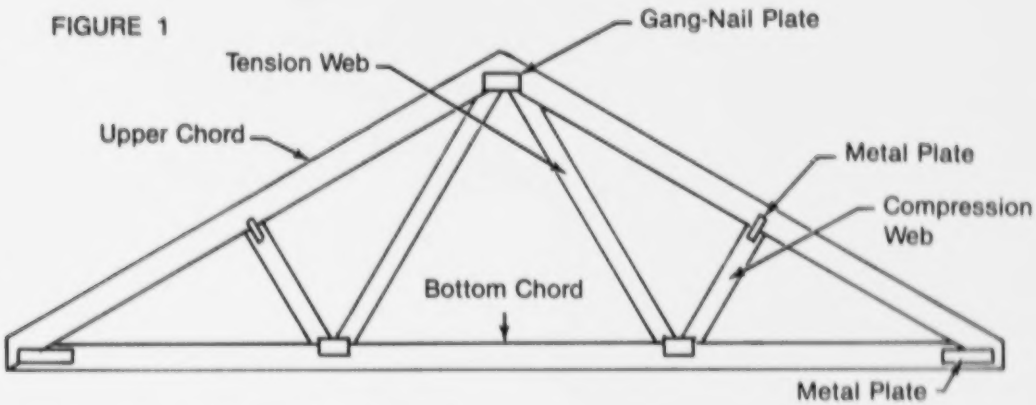
8. 1 - Upper cord pattern
9. 1 - Lower cord pattern
10. 1 - Gusset pattern
11. 1 - Tension web pattern
12. 1 - Compression web pattern
13. 2 x 4 lumber for truss parts
14. Metal plates or ½" plywood
15. 6d common nails
16. 8d box nails

JOB SHEET #6

B. Procedure

(NOTE: The roof truss will be constructed as shown in Figure 1 or as directed by your instructor.)

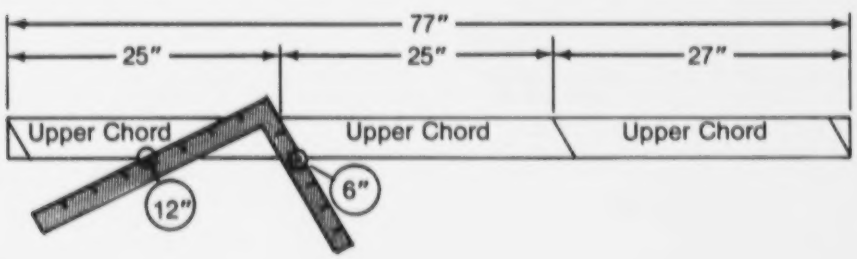
FIGURE 1



1. Layout and mark upper chord.

   (NOTE: Carpenters have a technique of laying out roof framing using a framing square to layout the upper chords. In this case the roof has a rise of 6" for every 12" of run. Your instructor may use different figures for layout detail.)

   FIGURE 2



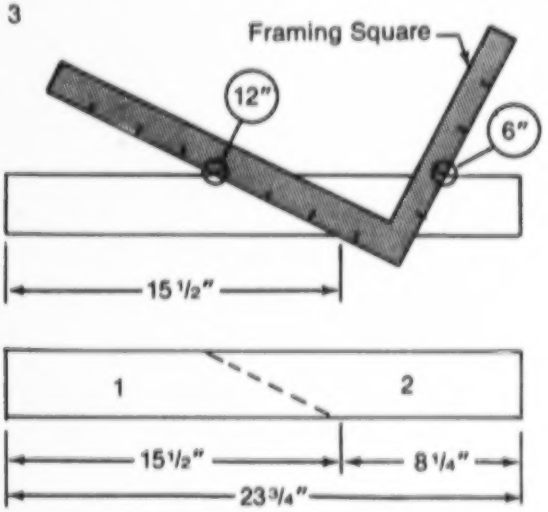
2. Double check your measurements; then saw the 2 × 4.

3. Saw one upper chord to length; then use it as a pattern to mark others.

JOB SHEET #6

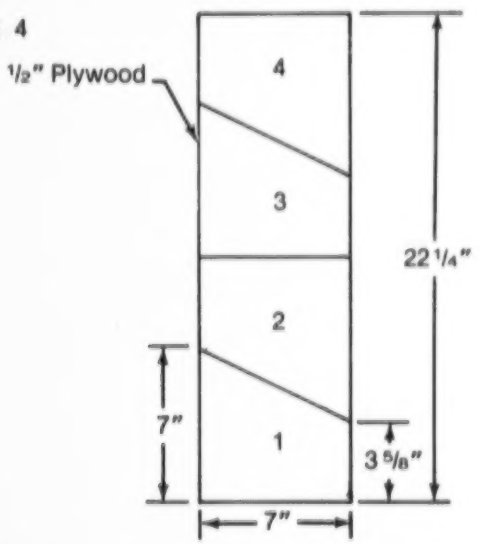
4. Layout and mark the lower chords. Use the framing square as shown in Figure 3.

FIGURE 3



5. Double check your measurements; then saw the 2 × 4.
6. Use it as a pattern to cut the remaining chords needed.
7. Layout, mark, and cut compression and tension webs as indicated by your instructor.
8. Layout and cut gussets from 1/2" plywood if they are to be used instead of metal plates.

FIGURE 4

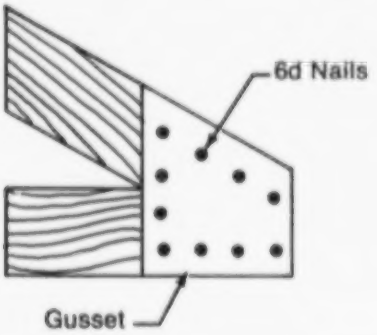


(NOTE: Use the first gusset as a pattern. Lay out and saw the remaining gussets.)

JOB SHEET #6

9. Place bottom truss and upper truss in position on work surface. Nail in place using metal plates or plywood gusset.

FIGURE 5



10. Nail compression and tension webs using the same procedure.

11. Check your work and have it evaluated by your instructor.

(NOTE: Several trusses will be needed for the construction project. Check with your instructor on how many trusses your work crew will need to construct for the project.)

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #7 — FRAME A ROOF

A. Materials and equipment

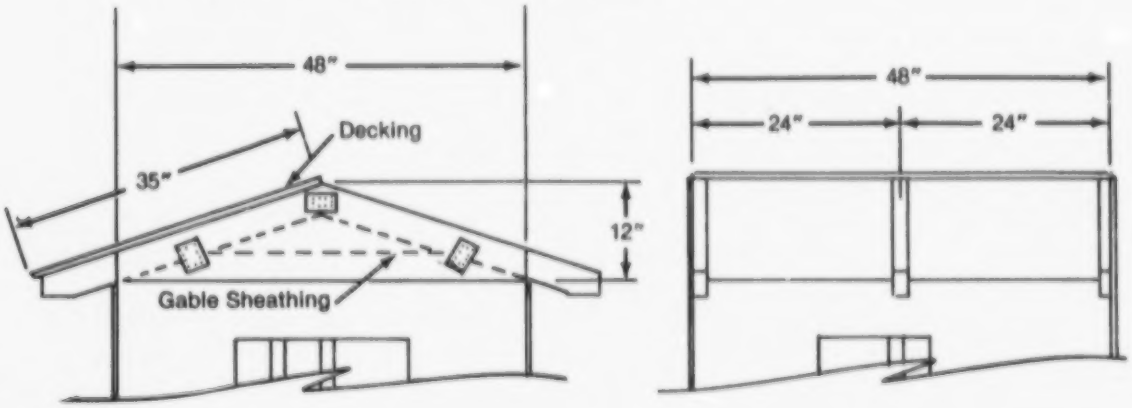
(NOTE: Each work crew will need the following.)

1. Trusses (preassembled or those constructed in Job Sheet #6)
2. Sheathing (½ in. × 12 in. × 48 in.)
3. Roof decking (½ in. × 35 in. × 48 in.)
4. Common nails, 6d
5. Common nails, 8d

B. Procedure

1. Identify a student as group leader to read the drawings and to make work assignments.
   a. Assign different carpenters to laying and cutting decking, gable end sheathing, and to locating and setting trusses.
   b. Carpenters should work in pairs to cut the decking.
2. Layout and saw the roof decking. Measure and saw carefully!
3. Layout the location of the trusses. (Figure 1)

FIGURE 1 — Truss, gable, and decking



JOB SHEET #7

4. Toenail trusses in place with 8d nails.
5. Nail roof decking in place with 6d nails.
6. Nail on gable end sheathing with 6d nails.
7. Report to the job superintendent when you have finished.
8. Clean up area.

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #8 — INSTALL SIDING

A. Materials and equipment

1. Hammer
2. Tape measure
3. Level
4. Saw
5. Framing square
6. Hard hats for each worker
7. Safety glasses for each worker
8. Hardboard siding
9. Box nails, galvanized 6d
10. 2 - Corner boards (1½ in. × 3½ in. × height of structure, 2 per side)
11. 1 - Starter strip (½ in. × 1 in. × length of wall)

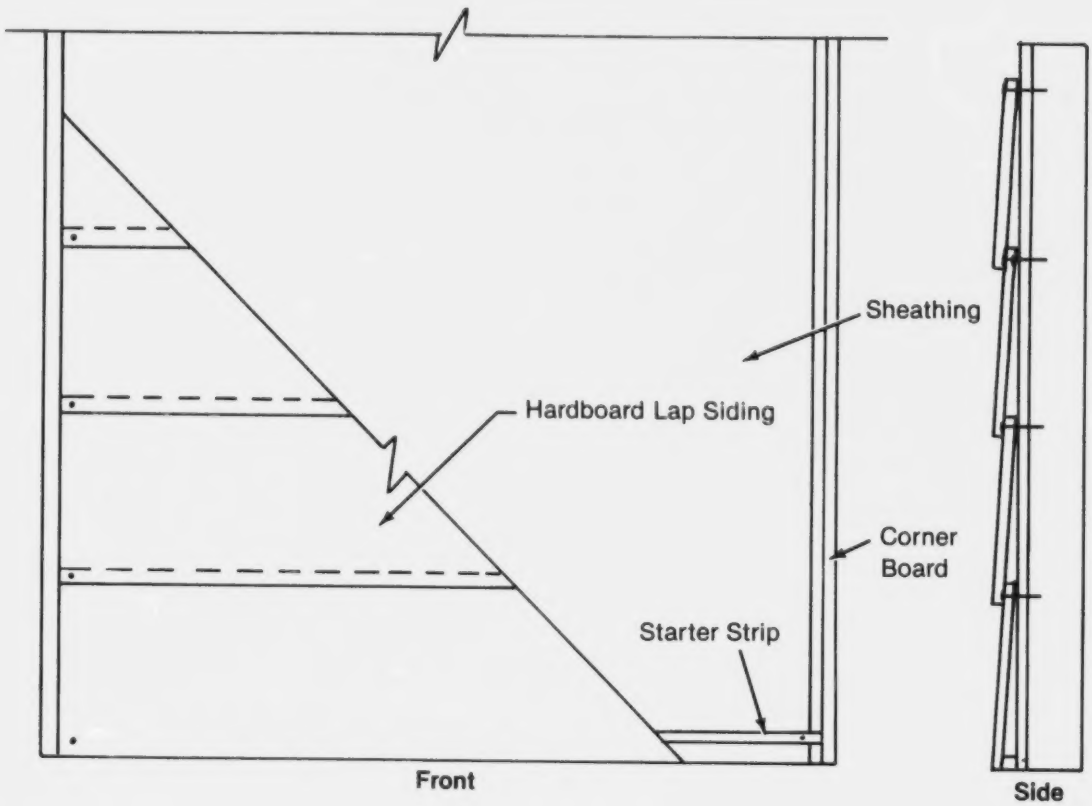
B. Procedure

(NOTE: There are many ways to cover outside wall surfaces such as hardboard lap siding, panels, aluminum or vinyl strips, or brick veneer. This job sheet uses hardboard lap siding. The owner [your instructor] will decide if other material is to be used.)

1. Identify a student as group leader to read the drawing and to direct the work. The following drawing shows how lap siding is installed.

JOB SHEET #8

FIGURE 1



JOB SHEET #8

2. Layout, cut, and nail the corner boards with 8d galvanized nails.

3. Cut and nail starter strips with 8d galvanized nails.

4. Measure the height of the wall to be covered with siding. Divide the distance into spaces as close as possible to the siding exposure.

5. Cut and nail siding with 8d galvanized box nails.

   a. The exposed portion should be the distance you find in Step 4.

   b. The distance should be the same on each course.

6. Report to your job superintendent when you have finished.

7. Clean up area.

CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #9 — ENCLOSE A ROOF

A. Materials and equipment

1. Hammers
2. Tape measure
3. Framing square
4. Tinner snips
5. Utility knife
6. Hard hats for each worker
7. Safety glasses for each worker
8. 2 - Rake boards (¾ in. × 2½ in. × 36 in.)
9. 1 - Flashing (10 ft. length for each side of the roof)
10. 1 - 15# roofing felt (3 ft. × 4 ft.)
11. Asphalt shingles, three-tab (12 in. × 36 in.)
12. Roofing nails, galvanized (1 in.)
13. Common nails, 8d

(NOTE: Equipment listed is needed for each group or crew. The instructor will supply the amount of shingles needed.)

B. Procedure

(NOTE: Pitched roofs are often covered with shingles. This job sheet will use three-tab asphalt shingles.)

1. Identify a roofing supervisor.
2. Form work groups.

(NOTE: Two crews could be formed, one to work on each side of the structure. The two crews will help with putting on the cap.)

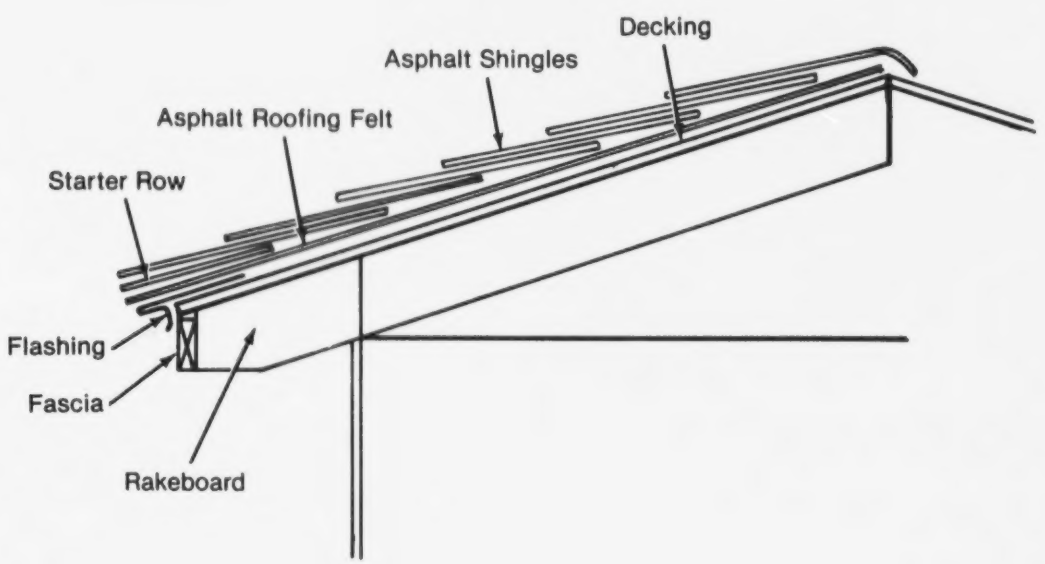
JOB SHEET #9

3. Assign other roofers to cut the flashing, roofing felt, and starter row of shingles.
4. The crew for the second half of the roof will do the following:
   a. Lay out and saw the rake board parts.

      (NOTE: The rake board is the same length as the rafter. It also has the same angles on the ends. Refer to Figure 1.)

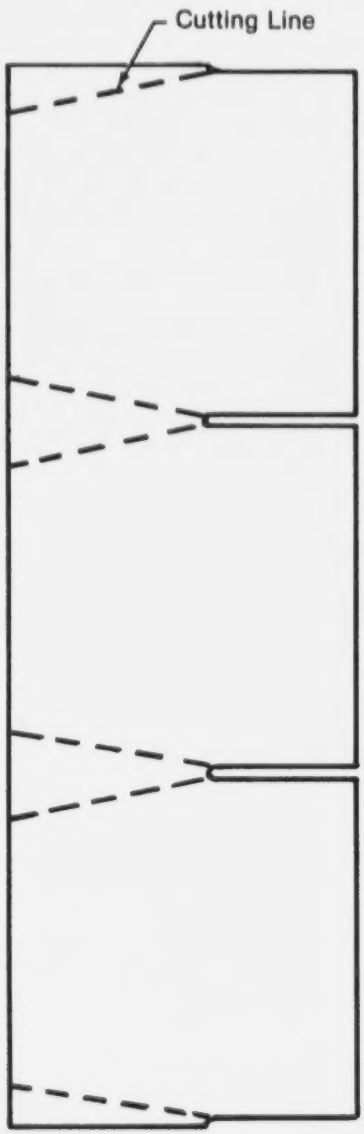
   b. Assign other roofers to cut the flashing, roofing felt, and starter row of shingles.
5. Nail the rake board in place with 8d nails.
6. Place the roofing felt on the decking.
7. Nail the flashing in place with 1 in. roofing nails.
8. Nail on starter row with 1 in. roofing nails. Follow the instructions on the shingle wrapper.
9. Cut, nail, and lay shingles in place until the roof is covered.
10. Cut cap pieces and nail in place. See Figure 2.
11. Report to the job superintendent when you have finished.
12. Clean up area.

FIGURE 1



JOB SHEET #9

FIGURE 2 — Cap angle cutting



CONSTRUCTION PROCESSES
UNIT V

JOB SHEET #10 — TRIM THE OUTSIDE OF THE STRUCTURE

A. Materials and equipment

1. 1 - Staple gun with 1/4 in. staples
2. 1 - Tinner snips
3. 1 - Caulking gun
4. 1 - Nail set
5. 1 - Ledger strip (3/4 in. × 1 1/2 in. × 8 ft. wood)
6. 1 - Fascia (3/4 in. × 3 1/2 in. × 9 ft. wood)
7. 1 - Soffit (1/4 in. × 7 3/4 in. × 8 ft. tempered hardboard)
8. 2 - Aluminum window screens (26 in. × 8 in. × 9 ft.)
9. 1 - Molding (3/4 in. quarter round)
10. 2 - Rake boards (3/4 in. × 3 1/2 in. × 7 ft. wood)
11. 1 - Caulking (tube)
12. Finish nails, galvanized, 8d
13. Common nails, 8d

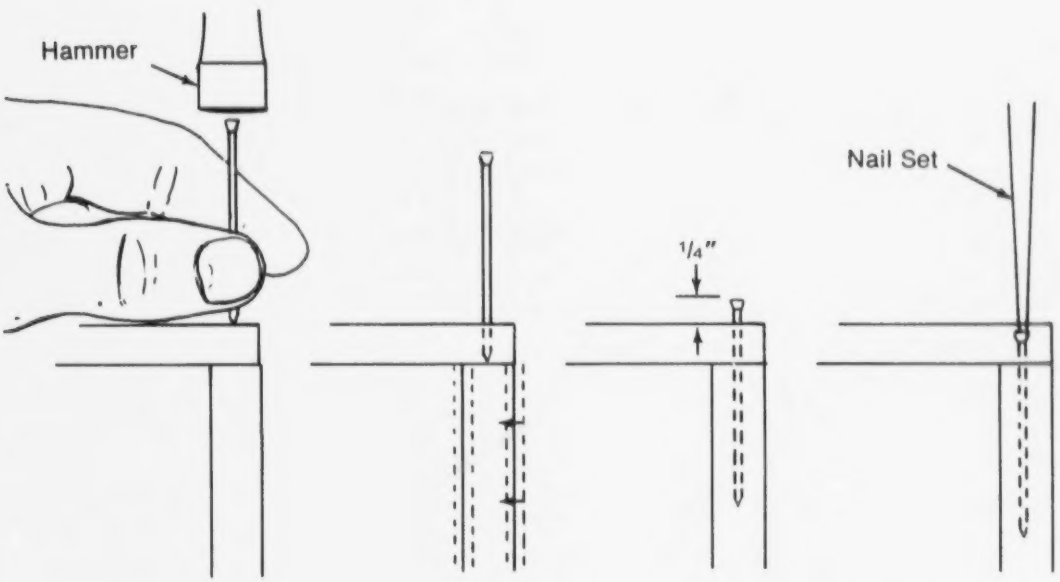
JOB SHEET #10

B. Procedure

(CAUTION: More than one task will be going on at the same time. Be aware of other workers. Wear your safety glasses and hard hat at all times. Work carefully because all work will show on the completed project.)

1. Nailing procedure used in this job sheet

FIGURE 1 — Finish nail



a. Start Nail b. Align Parts c. Drive Nail d. Set Nail

2. Identify a student as group leader to direct the work.

3. Enclose cornice as follows:

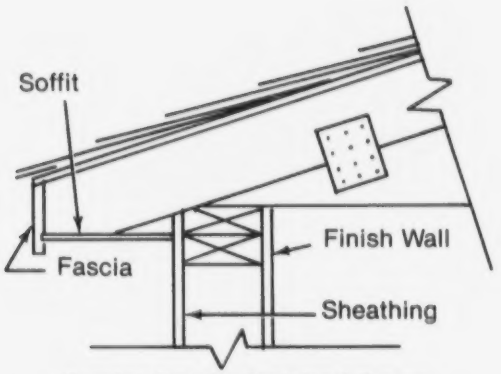
   a. Cut and nail ledger strip with 8d nails.

   b. Cut and nail fascia with 8d finish nails.

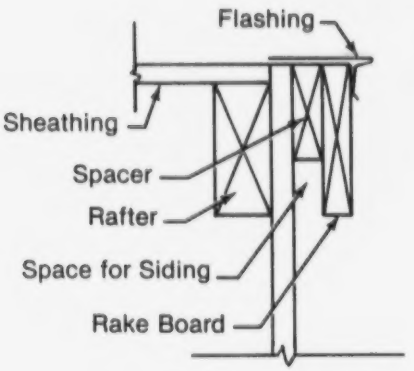
   c. Layout and cut openings in soffit. (See Figure 2 for details.)

JOB SHEET #10

FIGURE 2



Cornice Details for Wood Frame



Section View of Gable End

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEET #1 — POUR A CONCRETE FOUNDATION

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Used tools safely.	_____	_____
3. Followed plans or directions for building the forms.	_____	_____
4. Rebar was placed properly.	_____	_____
5. Reported when job was completed.	_____	_____
6. Checked in/put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
10. Practiced safety rules throughout procedure.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Forms met specifications				
	4	3	2	1
Concrete surface was smooth and level				
	4	3	2	1
Edges were finished correctly				
	4	3	2	1
Excess concrete was disposed of correctly				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEET #2 — BUILD A WOOD FRAME STRUCTURE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Used tools safely.	_____	_____
3. Used safety equipment correctly.	_____	_____
4. Cut framing lumber square.	_____	_____
5. Checked work for trueness.	_____	_____
6. Followed correct nailing practices.	_____	_____
7. Worked well as a team.	_____	_____
8. Checked in/put away tools and materials.	_____	_____
9. Cleaned the work area.	_____	_____
10. Used proper tools correctly.	_____	_____
11. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
12. Practiced safety rules throughout procedure.	_____	_____
13. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #2 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
	4	3	2	1
Frame was true when completed	4	3	2	1
All construction members were correctly placed				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEETS #3-4 — ROUGH IN COPPER AND PLASTIC WATER LINES

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Worked safely.	_____	_____
3. Worked accurately.	_____	_____
4. Worked accurately.	_____	_____
5. Followed plans as directed.	_____	_____
6. Checked in/put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
10. Practiced safety rules throughout procedure.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEETS #3-4 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Tubing and fittings were assembled correctly				
	4	3	2	1
Solder joint was correct				
	4	3	2	1
Solvent welded joint was correct				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEET #5 — ROUGH IN ELECTRICAL POWER SYSTEMS

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Worked as instructed.	_____	_____
3. Followed plans of project.	_____	_____
4. Worked safely.	_____	_____
5. Checked in/put away tools and materials.	_____	_____
6. Cleaned the work area.	_____	_____
7. Used proper tools correctly.	_____	_____
8. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
9. Practiced safety rules throughout procedure.	_____	_____
10. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #5 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Boxes were mounted correctly				
	4	3	2	1
Wires were connected properly				
	4	3	2	1
Project performed as designed				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEETS #6-7 — CONSTRUCT ROOF TRUSS AND FRAME A ROOF

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Worked safely on site and in laboratory.	_____	_____
3. Worked as a team member.	_____	_____
4. Exercised extra caution with ladder use.	_____	_____
5. Followed plans and directions.	_____	_____
6. Checked in/put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
10. Practiced safety rules throughout procedure.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEETS #6-7 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Truss was constructed correctly	4	3	2	1
Proper nailing procedures were used	4	3	2	1
Trusses were located correctly	4	3	2	1
Trusses were placed and nailed correctly				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

PRACTICAL TEST
JOB SHEETS #8-9-10 — INSTALL SIDING, ENCLOSE A ROOF, AND TRIM STRUCTURE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Used power equipment safely.	_____	_____
3. Followed plans or instructions.	_____	_____
4. Worked well as a team member.	_____	_____
5. Completed processes in correct sequence.	_____	_____
6. Checked in/put away tools and materials.	_____	_____
7. Cleaned the work area.	_____	_____
8. Used proper tools correctly.	_____	_____
9. Performed steps in a timely manner (___hrs.___min.___sec.)	_____	_____
10. Practiced safety rules throughout procedure.	_____	_____
11. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEETS #8-9-10 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Siding was applied neatly and correctly				
	4	3	2	1
Shingles were installed correctly				
	4	3	2	1
Trims were completed as instructed				
	4	3	2	1
Correct nailing procedures were followed				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

CONSTRUCTION PROCESSES
UNIT V

NAME _____ SCORE _____

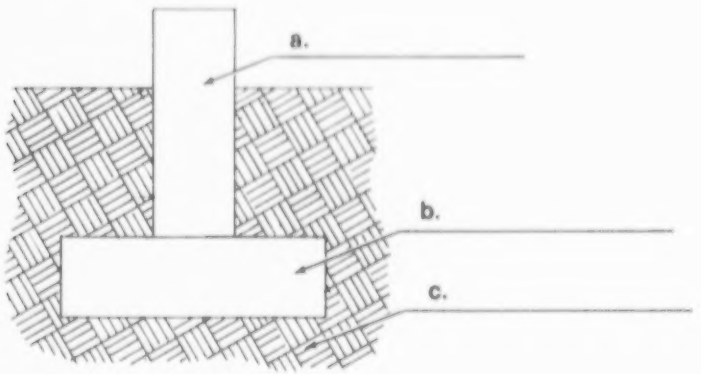
TEST

1. Match the terms on the right with the correct definitions.

_____a.	Pipes or ducts which move heat, water, or gas throughout a structure	1. Superstructure
_____b.	The sloped members of a roof framing	2. Rafters
_____c.	The part of a structure below the ground	3. Girders
_____d.	The horizontal supporting member that spans an opening in a wall and that usually carries the weight of the material over the opening	4. Joists
_____e.	The vertical members of a wall framing	5. Header (lintel)
_____f.	The part of the structure above the ground	6. Reinforcement
_____g.	Steel bars or wire mesh used in concrete for additional strength	7. Mechanical systems
_____h.	The horizontal members of floor or ceiling framings	8. Studs
		9. Foundation
		10. Roughed in
		11. Substructure

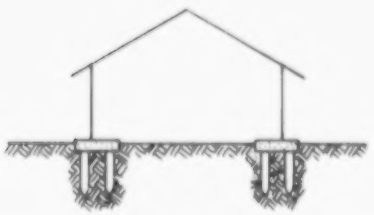
2. Label the three major parts of a foundation by supplying the correct words in the figure below.

   Load bearing surface, girder, foundation wall, lintel, header, footing

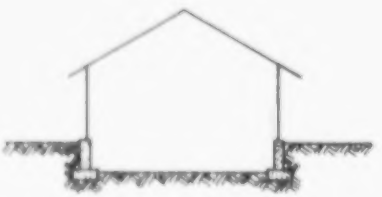


TEST

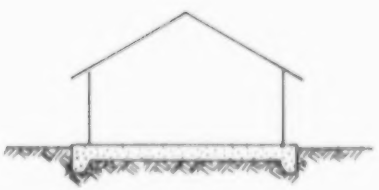
3. Identify types of foundations by labeling the figures below.



a. _____



b. _____



c. _____

4. Match materials used for foundations with the correct descriptions.

_____a.	Most common material used because of its strength and ability to support heavy loads	1. Natural materials
_____b.	Used in the construction of highways or runways; commonly used below other materials as a base	2. Steel
_____c.	Wood or stone may be used for piers, piles, or foundation walls	3. Crushed rock or gravel
_____d.	Used in the form of bars and wire mesh to reinforce the concrete or as piles	4. Concrete
		5. Aluminum

TEST

5. Arrange in order the steps in setting foundations by placing the correct numbers in the blanks.

   _____a. Provide permanent drainage.

   _____b. Complete earthwork.

   _____c. Add backfill.

   _____d. Place footings on load bearing surface.

   _____e. Place or build foundation walls for spread footings.

6. Match types of frames for superstructures with their correct descriptions.

   _____a. Usually built on site; however, some parts may be manufactured and set into place.

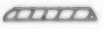
   _____b. Usually used for small structures such as houses. Consist of three major parts: floor framing, wall framing, and roof framing.

   _____c. Usually erected on site, piece by piece. Structural steel is used. It is made in a shop and sized to specifications according to an engineer's design drawings. Assembled structural steel is often subcontracted to a structural steel erector.

   1. Wood frame
   2. Steel frame
   3. Concrete frame

7. Identify structural steel shapes used in frame construction by writing the correct names below the figures.

   I beam, tee, channel, wide flange beam, plate, angle, bar joist



a. _____ b. _____

TEST

c. _____ d. _____

e. _____ f. _____ g. _____

8. Arrange in order the steps in constructing concrete frames by placing the correct numbers in the appropriate blanks.

   _____a. Fasten steel pieces temporarily using bolts, rivets, or welds.

   _____b. Fasten permanently.

   _____c. Plumb and brace the steel frame with guy wires.

   _____d. Lift steel pieces into place.

9. Complete the following statements concerning the steps in constructing concrete frames by supplying the correct words.

   a. Concrete frames are constructed using _____ and precast shapes.

   b. Concrete frames are made using the following steps:

      1) Build forms

      2) _____ _____

      3) Place concrete

      4) _____ _____

      5) Remove forms

   c. Concrete members are fastened or anchored together using _____.

TEST

10. Arrange in order the major steps in constructing wood frames by writing the correct sequence numbers (1-5) in the blanks.

    _____a. Level and plumb the frame.

    _____b. Layout and mark locations of framing members according to working drawings.

    _____c. Assemble the parts.

    _____d. Mark off the lengths of lumber.

    _____e. Saw the lumber.

11. Arrange in order the steps used in erecting a structure by writing the correct sequence numbers (1-6) in the blanks.

    _____a. Assemble wall frames.

    _____b. Lay subflooring on top of the joists and nail down.

    _____c. Assemble roof frame.

    _____d. Install roof decking.

    _____e. Set sills.

    _____f. Assemble joists.

12. Select the outside utility systems from the list below by placing an "X" preceding the correct words.

    _____a. Cable service

    _____b. Satellite

    _____c. Telephone service

    _____d. Sprinkler systems

    _____e. Electricity

    _____f. Sewage disposal

    _____g. Gas

    _____h. Water

TEST

13. Complete statements concerning inside utility systems by selecting the correct words.

    a. Climate control systems provide clean, conditioned (**air, water**) to make buildings comfortable.

    b. Filtering is a way of (**removing, purifying**) the air.

    c. Heated air travels through the building in (**ducts, pipes**).

    d. (**Electrical, Plumbing**) systems distribute liquids and gases throughout the building.

    e. The type of electrical system that moves or processes information throughout a building is the (**communication, power**) system.

14. Arrange in order the sequence for roughing in the inside utility systems by placing the correct numbers (1-3) in the appropriate blanks.

    _____a. Electrical wires used to distribute electrical energy.

    _____b. Ducts used to carry fresh, warm, or cool water.

    _____c. Pipes used to carry water, waste, gas, or other material.

15. State two reasons for insulating structures.

    a. _____

    b. _____

16. Complete the following chart of types of insulation and methods for adding them.

Type	*Method*
Rigid board	_____
_____	Poured, blown, or sprayed
Batts or blankets	Staples, wire, or friction
Reflective	Nails or glue

17. Select from the list below the common areas to insulate by placing an "X" in the correct blanks.

    _____a. Walls, ceilings, and floors

    _____b. Garage closets

TEST

_____c. Pipes and junction boxes on outside wall

_____d. Pipes carrying hot or chilled liquids

_____e. Most duct work

_____f. All concrete work

_____g. Under patio roofs

18. Complete statements concerning enclosing the exterior by circling the correct words.

    a. When enclosing a roof, the (**rafter, deck**) forms a connecting bridge across the framing members.

    b. (**Roofing, Insulation**) protects a building from rain and snow.

    c. (**Flashing, Caulking**) is used to stop leakage where the roof section joins another surface.

    d. Outside walls are often covered with (**drywall, brick**).

19. Complete statements concerning enclosing the interior by circling the correct words.

    a. Walls are most commonly finished using (**rough cedar, gypsum board**).

    b. Gypsum board (**may, may not**) be used for ceilings.

    c. Two types of subfloors are plywood and (**iron, concrete**).

20. Complete statements concerning finishing the project by circling the correct words.

    a. Finish work is done when (**outside, inside, both outside and inside**) construction of structure is finished.

    b. Finish work is done for (**sanitation, appearance**), protection, and usefulness.

    c. Finish work includes (**trimming, framing**), painting, (**remodeling, decorating**), and installing.

    d. Most fixtures are installed (**before, during, after**) other finishing procedures.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

21. Demonstrate the ability to:

    a. Pour a concrete foundation. (Job Sheet #1)

    b. Build a wood frame structure. (Job Sheet #2)

    c. Rough in copper water lines. (Job Sheet #3)

    d. Rough in plastic water lines. (Job Sheet #4)

    e. Rough in electrical power systems. (Job Sheet #5)

    f. Layout and construct a roof truss. (Job Sheet #6)

    g. Frame a roof. (Job Sheet #7)

    h. Install siding. (Job Sheet #8)

    i. Enclose a roof. (Job Sheet #9)

    j. Trim the outside of a structure. (Job Sheet #10)

CONSTRUCTION PROCESSES
UNIT V

ANSWERS TO TEST

1. a. 7
   b. 2
   c. 11
   d. 5
   e. 8
   f. 1
   g. 6
   h. 4

2. a. Foundation wall
   b. Footing
   c. Load bearing surface

3. a. Pile foundation
   b. Spread foundation
   c. Slab foundation

4. a. 4
   b. 3
   c. 1
   d. 2

5. a. 4
   b. 1
   c. 5
   d. 2
   e. 3

6. a. 3
   b. 1
   c. 2

7. a. Plate
   b. I Beam
   c. Bars
   d. Angle
   e. Wide flange beam
   f. Channel
   g. Tee

8. a. 2
   b. 4
   c. 3
   d. 1

9. a. Columns, beams, or slabs
   b. 2) Set reinforcement
      4) Cure concrete
   c. Dowels (reinforcing steel), trussed bar, and other methods

10. a. 5
    b. 1
    c. 4
    d. 2
    e. 3

ANSWERS TO TEST

11. a. 4 d. 6
    b. 3 e. 1
    c. 5 f. 2

12. a. X e. X
    b. 0 f. X
    c. X g. X
    d. 0 h. X

13. a. 3
    b. 1
    c. 2

14. a. Air
    b. Purifying
    c. Ducts
    d. Plumbing
    e. Communication

15. Any two of the following:
    a. To save money
    b. To increase comfort
    c. To conserve energy

16. a. Nails or glue
    b. Loose fill

17. a. X e. X
    b. 0 f. 0
    c. X g. 0
    d. X

18. a. Deck
    b. Roofing
    c. Flashing
    d. Brick

19. a. Gypsum board
    b. May
    c. Concrete

20. a. Both outside and inside
    b. Appearance
    c. Trimming, decorating
    d. After

21. Performance skills evaluated to the satisfaction of the instructor

PROJECT COMPLETION
UNIT VI

UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a group member in the landscaping and closing process of a construction project. Competencies will be demonstrated by completing the assignment sheets, the job sheet, and the unit tests with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Define landscaping.
2. State the purposes of landscaping.
3. Arrange in order the steps in the landscaping process.
4. Complete statements concerning landscaping procedures.
5. Complete statements concerning transferring the project.
6. Select true statements concerning the final inspection.
7. Arrange in order the steps in closing a contract.
8. Match procedures for servicing the project with the correct descriptions.
9. Make a landscape plan. (Assignment Sheet #1)
10. Make final inspections. (Assignment Sheet #2)
11. Close the contract. (Assignment Sheet #3)
12. Demonstrate the ability to plant a site. (Job Sheet #1)

PROJECT COMPLETION
UNIT VI

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make a transparency from the transparency master included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Provide students with job sheet.

H. Discuss and demonstrate the procedure outlined in the job sheet.

I. Integrate the following activities throughout the teaching of this unit:

1. Invite a landscape architect to visit the class.

2. Plan to have the students develop a new landscape plan for their backyard. Have them call or visit a nursery to find the cost of carrying out their plans.

3. Have students visit a construction site that is being landscaped. Make a list of tools and equipment needed for the process.

4. Discuss how to save energy by landscaping.

5. For career requirements and information about landscape architects, contact:

   American Society of Landscape Architects, Inc.
   1750 Old Meadow Road
   McLeon, Virginia 22101

6. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

B. Lux, Donald G., et. al. *World of Construction.* Bloomington, IL: McKnight Publishing Co., 1982.

C. Feirer, John L. and Gilbert R. Hutchings. *Guide to Residential Carpentry.* Peoria, IL: Bennett Publishing Co., 1983.

D. Spence, William P. *Architecture.* Peoria, IL: Bennett and McKnight Publishing Co., 1985.

PROJECT COMPLETION
UNIT VI

INFORMATION SHEET

I. **Definition of landscaping**

A. Changing the scenery on a site so it can be used and enjoyed by humans.

B. Includes clearing and repairing the site after construction as well as planting the site.

II. **Purposes of landscaping**

A. To improve appearance — A site that is well-landscaped is more appealing. The home owners will be more pleased with their home if it is well-landscaped, and prospective owners will view the home as more desirable.

B. To improve the living environment — Correctly placed plants and outdoor structures can improve the inside and outside living temperatures and amount of sun as well as aid in noise, odor, and pollution control.

C. To conserve energy — By orienting a structure to the prevailing winds, natural breezes in the summer can reduce air-conditioning needs and the use of evergreen trees and shrubs as windbreaks can reduce heating needs. Also proper orientation to the sun and the proper use of deciduous trees can allow passive heating which can greatly reduce heating bills.

III. **Steps in the landscaping process** (Transparency 1)

A. Complete final earthwork.

(NOTE: This earthwork is done mainly for appearance rather than for structural support.)

1. Replacing earth — Soil that has been saved from excavating (digging a basement or laying lines, etc.) is used for backfill. Topsoil is replaced in order to have good soil for growing grass, trees, and shrubs.

2. Shaping earth — Some landscape plans call for mounds of earth or flat places on the site. These contours may be planned to provide drainage as well as beauty or interest. Bulldozers and graders move, level, and mix soil. Loaders and scrapers move soil to where it is needed or remove excess soil. Small jobs are done with shovels, rakes, and wheelbarrows.

INFORMATION SHEET

B. Provide access to building and add outdoor fixtures.

1. Building accesses — Driveways, parking areas, and sidewalks are added.

   (NOTE: Driveways and parking areas are normally made of concrete because of the strength needed to bear vehicles. Sidewalks may be made of concrete, brick, treated lumber, stone, gravel, or bark.)

2. Building outdoor fixtures — Lights, signs, decks, railings, seats, and sprinkler systems may be added for safety and enjoyment.

C. Plant the site — Trees, shrubs, ground covers, and grass make a site and structure look more natural and appealing. The architect often designs the building to fit the natural setting. If land is plain or flat, it may be changed to make a more pleasant setting.

D. Clean the site — Involves picking up and disposing of all debris.

Examples: Removing empty bottles, cans, boxes, and scraps

(NOTE: Cleaning also includes removing any straw or burlap from lawn projects once the lawn is established.)

IV. **Landscaping procedures** (Assignment Sheet #1 and Job Sheet #1)

A. Cultivate — The process of preparing the soil using tillers or harrows. The soil is broken and fertilizer is spread and mixed to give the plants better growth.

(NOTE: Other chemicals may be added to improve the soil or to control harmful insects and weeds. These chemicals must be mixed, handled, and applied with great care.)

FIGURE 1

INFORMATION SHEET

B. Plant — Trees, shrubs, and flowers. A landscape plan describes the kind and placement of all plantings.

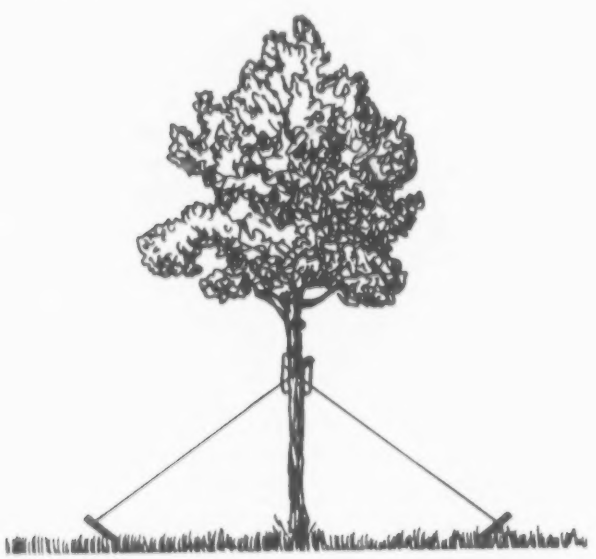
(NOTE: When timing is important, a planting schedule is used.)

1. Trees and shrubs require the proper size hole. The bottom third of the hole is filled with water.

   (NOTE: This is to prevent air pockets around the roots and to soften the soil.)

   The tree or shrub is placed in the hole and the soil is replaced and packed around the roots. No air should remain around the roots. Trees may require extra support until the root system is established.

   FIGURE 2



   (NOTE: There are several things to consider when selecting trees or shrubs such as how big they will be when mature, and what purpose they should serve such as giving shade, ornamental beauty, or year round greenery.)

2. Ground cover are used to prevent the soil from washing away and to cover unattractive soil.

   a. Materials used for ground cover include grass, low spreading plants, and wood or mineral products for mulch.

   b. Lawns are the most common ground covers and may be started by planting seed or placing sod.

      (NOTE: Seeding is less expensive but takes more time to grow. Placing sod is fast but expensive.)

INFORMATION SHEET

V. **Transferring the project**

A. When all work is completed, the project is transferred from the contractor to the owner. The contract is used to guide this process.

B. The contract sets out the following guidelines for a successful project.

1. States the specifications for the project
2. Describes the materials, methods, and quality of work
3. Spells out the process used to inspect and correct defects
4. States the standards for paying bills
5. Describes the warranties
6. Tells how the final payment is to be made

VI. **Final inspection** (Assignment Sheet #2)

(NOTE: Inspections were made throughout the construction. Plans were approved before a building permit was issued. Inspections continued throughout the construction process. The final inspection concentrates on appearance and mechanical equipment.)

A. Who inspects?

1. Public officials — Inspect to ensure public safety. They see that the structure is strong enough.
2. Project designers — Inspect to see that the design plan is carried out.
3. Financial lenders — Inspect to insure investors that the construction is a good investment. They must be satisfied with both materials and workmanship used on the project.
4. Owners — Often the project designers or engineers represent the owners for the inspection process.

B. What is inspected?

1. Materials — Before building permits are issued, materials are checked to make sure they meet code. After the plans are approved, they become the guide. The final inspectors check the surface materials.

Examples: Trim, paint, plantings, and fixtures are checked against the plan

INFORMATION SHEET

2. Methods — There are many ways to do a job. Specifications state how work is to be done. Inspectors check to make sure these guidelines have been followed.

3. Quality — May be checked in several ways. Inspectors may answer the following questions: Does it work? Is it the right size? Does it look good?

C. How are defects corrected?

1. Any defects are placed on a punch list.

2. Each item must be corrected by the responsible firm.

3. After items are corrected, an approved form is signed by the final inspector.

VII. Closing the contract (Assignment Sheet #3)

(NOTE: At the closing, the owner pays the contractor and receives the following signed documents from the contractor.)

A. Approvals — After final details such as final cleanup and painting or trim work are completed and all defects are corrected, the inspector is brought back and a certificate of completion form is signed. This includes a warranty which provides for correction of any faulty work.

B. Releases — In construction, a contract means that people promise to do things for a fee. The contract describes these promises and fees. In the event these payments are not met, complaints of non-payment are filed.

Examples: Claims, liens

(NOTE: When a project is completed and the owner gets a Release of Lien, this means nothing is owed against the project.)

C. Warranties and manuals

1. A warranty is a document giving a guarantee that there are no defects. The contractor and supplier state there are no defects in work or materials and they are guaranteed to last a period of time.

Examples: One year warranty or 20 year warranty

2. Manuals — Equipment suppliers provide manuals that describe how to operate and maintain the equipment. All manuals are turned over to the owner at the time of closing.

D. Final payment — After the above steps are concluded along with the certificate of completion, the owner makes the final payment. The contractor's responsibility ends (except for warranties) and the contract is closed.

INFORMATION SHEET

VIII. Servicing the project

(NOTE: After a contract is closed, the owner must service the project.)

A. Operation — May include obtaining or training operators to check equipment, gauges, or using dials that show how well machines or equipment is working.

Examples: Climate control equipment, etc.

B. Maintenance — Extends the life of the structure. May be scheduled, preventive, or routine.

C. Repairs — Parts of a project that fail must be repaired. Repairs should be done right away. Delays often make the problem worse.

Examples: Worn out switches, leaking roofs or faucets

D. Protection — Shielding projects from damage, theft, and fire using fences, patrols, and monitoring devices.

E. Changes and alterations — May include installing different equipment or changing the size of a structure. These alterations must be serviced just like a new structure.

Steps in Landscaping

1. COMPLETE final earthwork.
2. PROVIDE access to building and add outdoor fixtures.
3. PLANT the site.
4. CLEAN the site.

PROJECT COMPLETION
UNIT VI

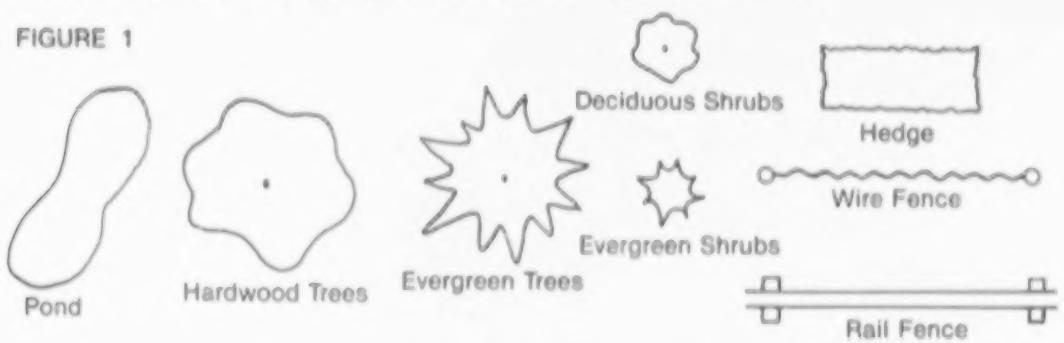
ASSIGNMENT SHEET #1 — MAKE A LANDSCAPE PLAN

NAME _____ SCORE _____

NAME _____ SCORE _____

Direction: All landscaping work begins with a plan. In this assignment you are to work in teams and make a landscape plan. Use the landscape symbols below.

FIGURE 1



1. Identify a lead architect in your group. (You may wish to name your firm.)
2. Identify the project.

   Examples: a. If you built an actual structure, plan a landscape for it.
   b. Develop a landscape plan for an area around your school.
   c. Develop a plan to landscape the site box.

3. Develop ideas by brainstorming alternatives.

   (NOTE: Remember the rules of brainstorming.)

   a. All ideas are good.

   b. Make no judgment until brainstorming is over.

   c. The more ideas, the better.

   d. Build on other ideas.

4. Refine your ideas to produce the final idea.
5. Analyze your ideas to make sure they work.

ASSIGNMENT SHEET #1

6. Select the best idea.

7. Implement the idea by making a finished drawing on grid paper provided by your instructor.

   (NOTE: Make your drawing to 1/4 scale [1/4" = 1'].)

8. Turn in your final plan to your instructor.

Evaluation criteria

1. Was the site appearance improved?

2. Will the site's living environment be improved?

3. Will the landscape design assist in conserving energy?

PROJECT COMPLETION
UNIT VI

ASSIGNMENT SHEET #2 — MAKE FINAL INSPECTIONS

NAME _____ SCORE _____

Directions: The construction superintendent or your instructor will assign inspection roles and tell you which of the following checklist(s) to complete:

1. Project designer's inspection checklist
2. Owner's inspection checklist
3. Building inspector's inspection checklist
4. Lender's inspection checklist

After completing the checklist, fill out the Punch List and give it to the contractor. Each item should be corrected, negotiated, or explained to the person in authority.

ASSIGNMENT SHEET #2

ASSIGNMENT SHEET #2

PROJECT DESIGNER'S INSPECTION CHECKLIST

Use the inspection checklist below. It will help you to check each item. You may add items to be checked if needed. The items that pass inspection are checked under the S (Satisfactory). Those that do not pass are checked under the U (Unsatisfactory). Make a list of the unsatisfactory items on the PUNCH LIST.

	S	U
1. Is the roofing put on according to the drawings?		
2. Do the exterior wall coverings meet specifications? a. Siding b. Trim c. Window d. Door		
3. Are all cracks sealed? a. Correct moldings b. Correct caulking c. Neatly installed		
4. Was the specified paint used and applied correctly? a. Type b. Color c. Method		
5. Were the same materials that were specified correctly installed? a. Ceiling b. Walls c. Floors		
6. Was the electrical circuit and devices installed according to specifications? a. Switch b. Outlet c. Light d. Conductors		
7. Were the specified materials used and were pipes installed correctly? a. DWV b. Hot water c. Cold water d. Gas e. Sink		
8. Was the doorbell that was specified used?		

ASSIGNMENT SHEET #2

PUNCH LIST

To: Contractor _____ Date: _____

From: Project Designer _____

Subject: Inspection and Punch List for _____
(Project Name)

The items on the list below were found to be unsatisfactory. They must be corrected before the Certificate of Completion is signed.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

_____
(Signature)

ASSIGNMENT SHEET #2

OWNER'S INSPECTION CHECKLIST

Use the inspection checklist below. It will help you to check each item. You may add items to be checked if needed. The items that pass inspection are checked under the S (Satisfactory). Those that do not pass are checked under the U (Unsatisfactory). Make a list of the unsatisfactory items on the PUNCH LIST.

	S	U
1. Were roofing materials put on correctly and neatly?		
2. Was the exterior wall surface installed correctly and neatly? a. Siding b. Trim c. Window		
3. Are all cracks sealed? a. Neatly done b. Correct materials c. Infiltration of air kept to a minimum		
4. Was the painted exterior surface painted correctly? a. Correct type of paint b. Right color c. Painting Technique		
5. Were the materials used to finish the interior surfaces properly installed? a. Ceiling b. Walls c. Floors		
6. Do the electrical circuits work? a. Switch b. Outlet c. Light		
7. Are the plumbing fixtures installed in the correct place and do they work? a. DWV b. Hot water c. Cold water d. Gas e. Sink		
8. Does the doorbell work?		

ASSIGNMENT SHEET #2

PUNCH LIST

To: Contractor _____ Date: _____

From: Project Owner _____

Subject: Inspection and Punch List for _____
(Project Name)

The items on the list below were found to be unsatisfactory. They must be corrected before the Certificate of Completion is signed.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

_____
(Signature)

ASSIGNMENT SHEET #2

BUILDING INSPECTOR'S INSPECTION CHECKLIST

Use the inspection checklist below. It will help you to check each item. You may add items to be checked if needed. The items that pass inspection are checked under the S (Satisfactory). Those that do not pass are checked under the U (Unsatisfactory). Make a list of the unsatisfactory items on the PUNCH LIST.

	S	U
1. Does the roofing material meet fire codes?		
2. Do wall coverings meet fire codes? a. Siding b. Trim c. Window d. Door		
3. Are all cracks sealed so insects and birds cannot enter? a. Around door and window b. At cornice		
4. Does the paint that was used pose a health hazard? a. Nontoxic b. Fire retardant		
5. Are the materials used in the ceiling, walls, and floor safe? a. Fire retardant b. Nonskid c. Nontoxic		
6. Are the electrical materials and methods safe? a. Grounded circuit b. 12 gauge conductors c. Device covers in place d. Wiring concealed		
7. Is the plumbing system installed according to code? a. DWV b. Hot water c. Cold water d. Gas e. Sink		
8. Does the doorbell use low voltage current?		

ASSIGNMENT SHEET #2

PUNCH LIST

To: Contractor _____ Date: _____

From: Building Inspector _____

Subject: Inspection and Punch List for _____
(Project Name)

The items on the list below were found to be unsatisfactory. They must be corrected before the Certificate of Completion is signed.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

_____
(Signature)

ASSIGNMENT SHEET #2

LENDER'S INSPECTION CHECKLIST

Use the inspection checklist below. It will help you to check each item. You may add items to be checked if needed. The items that pass inspection are checked under the S (Satisfactory). Those that do not pass are checked under the U (Unsatisfactory). Make a list of the unsatisfactory items on the PUNCH LIST.

	S	U
1. Was all roofing that was purchased used?		
2. Did the builder use the quality of exterior surfacing that was specified? a. Siding b. Trim c. Window d. Door		
3. Was the caulking that was purchased used to seal cracks?		
4. Was the paint that was purchased used on the exterior of the structure?		
5. Were all of the materials used that were purchased to finish the interiors? a. Ceiling b. Walls c. Flooring		
6. Was the money spent for the correct kind and number of electrical devices? a. Switch b. Outlet c. Light fixture d. Conductors		
7. Were the plumbing lines that were specified put in place? a. DWV b. Hot water c. Cold water d. Gas e. Sink		
8. Was the doorbell installed?		

ASSIGNMENT SHEET #2

PUNCH LIST

To: Contractor _____ Date: _____

From: Project Lender _____

Subject: Inspection and Punch List for _____
(Project Name)

The items on the list below were found to be unsatisfactory. They must be corrected before the Certificate of Completion is signed.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

_____
(Signature)

PROJECT COMPLETION
UNIT VI

ASSIGNMENT SHEET #3 — CLOSE THE CONTRACT

NAME _____ SCORE _____

Directions: Your instructor will set up the meeting. The following individuals will attend:

a Owner

b. Project designer

c. Government officials

d. Financial lender

e. Contractor

f. Secretary

The following agenda may be used.

1. Announcements
2. Contractor provides signed approvals, releases, warranties, and manuals to owner.
3. "Certificate of Completion" is signed. (next page)
4. Owner makes final payment.
5. Meeting is adjourned.

ASSIGNMENT SHEET #3

CERTIFICATE OF COMPLETION

The _____ project at
(Project Name)
_____ in _____ of _____
(Address) (City) (State)
is complete. All releases and approvals are signed, and manuals are provided.

The Warranty Period begins on _____ and ends
(Date)
on _____
(Date)

Copy exhibits received the _____ day of _____, _____.
(Day) (Month) (Year)

Contractor _____ Owner _____
(Signature) (Signature)

Lender _____ Designer _____
(Signature) (Signature)

Building Inspector _____
(Signature)

Evaluation criteria

1. Was meeting held in a professional manner?
2. Were all forms filled out legibly?
3. Did all those participating cooperate fully in the closing process?

PROJECT COMPLETION
UNIT VI

JOB SHEET #1 — PLANT A SITE

(NOTE: Your instructor will give you instructions to plant one of the following:

The structure you built
An area in the school yard
Model vegetation in the site box.)

The following is for a site box exercise.

A. Equipment and material

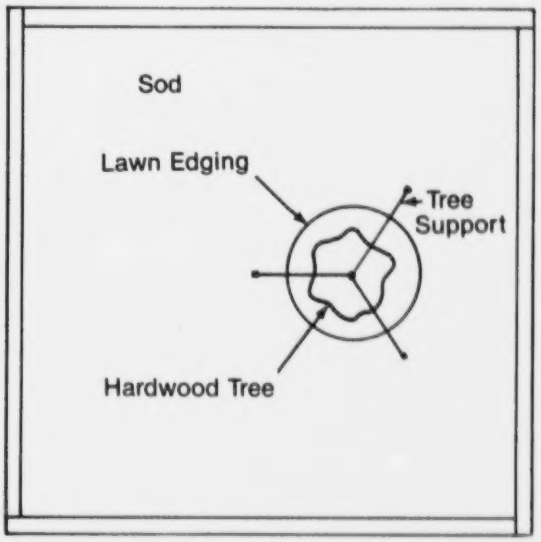
1. 1 - Toy hand rake
2. 1 - Garden trowel
3. 1 - Lawn edging (1/2 in. × 24 in. strip)
4. 1 - Tree (12 in. × 18 in.)
5. Sod (3 in. × 6 in.)
6. Fertilizer (sand)
7. 3 - Stakes (1/4 in. × 3 in. dowel)
8. 3 - Tree supports (12 in. mason's line)

JOB SHEET #1

B. Procedure

1. Identify the landscape supervisor. This person will read the drawing in the landscape plan below.

FIGURE 1



2. Get tools and plantings.
3. Layout and plant trees. Drive stakes and place the support lines.
4. Place the lawn edging.
5. Prepare the soil for the lawn.
6. Fertilize the soil. Work it into the soil.
7. Clean up the work site.

PROJECT COMPLETION
UNIT VI

JOB SHEET #1 PRACTICAL TEST — PLANT A SITE

STUDENT'S NAME _____ DATE _____

EVALUATOR'S NAME _____ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	_____	_____
2. Interpreted landscape plans correctly.	_____	_____
3. Followed correct planting procedures.	_____	_____
4. Checked in/put away tools and materials.	_____	_____
5. Cleaned the work area.	_____	_____
6. Used proper tools correctly.	_____	_____
7. Performed steps in a timely manner (___hrs. ___min. ___sec.)	_____	_____
8. Practiced safety rules throughout procedure.	_____	_____
9. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS: _____

_____

JOB SHEET #1 PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
	4	3	2	1
Used correct planting procedures				
	4	3	2	1
Passed a final inspection				

EVALUATOR'S COMMENTS: _____

_____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

PROJECT COMPLETION
UNIT VI

NAME _____ SCORE _____

TEST

1. Define landscaping in the space below.

_____

_____

_____

_____

_____

2. State two purposes of landscaping.

a. _____

b. _____

3. Arrange in order the steps in the landscaping process by placing the correct sequence numbers (1-4) in the appropriate blanks.

_____a. Plant the site.

_____b. Complete final earthwork.

_____c. Clean the site.

_____d. Provide access to building and add outdoor fixtures.

4. Complete statements concerning landscaping procedures by circling the correct words.

a. To (**spray, cultivate**) is to prepare the soil using tillers and harrows.

b. A (**floor, landscape**) plan describes the kind and placement of all plantings.

c. (**Ground covers, Trees**) are used to prevent soil from washing away and to cover unattractive soil.

d. (**Sidewalks, Lawns**) are the most common ground covers.

TEST

5. Complete statements concerning transferring the project by circling the correct words.

   a. When all work is completed, the project is transferred from the contractor to the **(owner, designer)**.

   b. A **(bill, contract)** is used to guide this process.

6. Complete the following statements concerning the final inspection by correctly filling in the blanks.

   a. Name one individual who makes a final inspection. _____

   _____

   b. What is inspected? _____

   _____

   c. How are defects corrected? _____

   _____

7. Arrange in order the steps in closing a contract by placing the correct sequence numbers (1-4) in the appropriate blanks.

   _____a. Releases are obtained.

   _____b. Warranties and manuals are gathered.

   _____c. Final payment is made.

   _____d. Approvals are written.

8. Match procedures for servicing the project on the right with the correct descriptions.

   _____a. May include obtaining or training operators to check equipment, gauges, or using dials that show how well machines or equipment is working.

   _____b. Extends the life of the structure. May be scheduled, preventive, or routine.

   _____c. Parts of a project that fail must be fixed and should be done right away. Delays often make the problem worse.

   _____d. Shielding projects from damage, theft, and fire using fences, patrols, and monitoring devices.

   _____e. May include installing different equipment or changing the size of a structure. These must be serviced just like a new structure.

   1. Repairs
   2. Changes and alterations
   3. Operation
   4. Protection
   5. Maintenance

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Make a landscape plan. (Assignment Sheet #1)

10. Make final inspections. (Assignment Sheet #2)

11. Close the contract. (Assignment Sheet #3)

12. Demonstrate the ability to plant a site. (Job Sheet #1)

PROJECT COMPLETION
UNIT VI

ANSWERS TO TEST

1. Either of the following definitions:
   a. Changing the scenery on a site so it can be used and enjoyed by humans.
   b. Includes clearing and repairing the site after construction as well as planting the site.

2. Any two of the following:
   a. To improve appearance
   b. To improve the living environment
   c. To conserve energy

3. a. 3
   b. 1
   c. 4
   d. 2

4. a. Cultivate
   b. Landscape
   c. Ground covers
   d. Lawns

5. a. Owner
   b. Contract

6. Any one answer for each of the following:
   a. Public official, project designer, financial lender, owner
   b. Materials, methods, quality
   c. Defects are placed on a punch list. Each must be corrected by the responsible firm.

7. a. 2
   b. 3
   c. 4
   d. 1

8. a. 3
   b. 5
   c. 1
   d. 4
   e. 2

9.-12. Evaluated to the satisfaction of the instructor.